A REVIEW OF AERIAL SPRAYING TECHNOLOGY FOR SPRUCE BUDWORM CONTROL IN PRIVATE WOODLOTS IN EASTERN QUEBEC

Forestry Canada
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A REVIEW OF AERIAL SPRAYING TECHNOLOGY FOR SPRUCE BUDWORM CONTROL IN PRIVATE WOODLOTS IN EASTERN QUEBEC

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Aussi disponible en français sous le titre « Revue des opérations techniques de pulvérisations aériennes contre la tordeuse des bourgeons de l'épinette dans les forêts privées de l'est du Québec ».

This publication reports research involving pesticides. All pesticides must be handled and applied properly according to directions. All pesticides are registered by Agriculture Canada for experimental use and have provincial approval before they can be applied.

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5. ASSESSING LARVAL AND FOLIAGE DEVELOPMENT, DEFOLIATION, AND TREATMENT EFFICIENCY

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INTRODUCTION

Within the framework of the Forestry Program of the Eastern Quebec Development Plan, Forestry Canada, Quebec Region sponsors a protection program against the spruce budworm (*Choristoneura fumiferana* Clem.) for private woodlots. Initiated in 1985, this program required close cooperation between representatives from various organizations and agencies. This cooperative effort resulted in the development of several original projects which successfully took into account the private character of the woodlots involved, the division of the territory, and the involvement of the woodlot producers' associations.

More precisely, the private woodlot protection program, which is the subject of these technical leaflets, is concerned with all of the steps of aerial spraying of the biological insecticide *Bacillus thuringiensis* (*B.t.*) to control spruce budworm. The aim of this spray program was to keep infested balsam fir and spruce stands alive and to spread out the harvest to more effectively meet market demand. Between 1985 and 1988 inclusively, some 69 000 ha were treated.

The originality of the method developed to meet the protection requirements of private woodlots led Forestry Canada to prepare reference documents to disseminate the acquired knowledge to other organizations involved in developing protection programs for private woodlots.

The resulting five technical leaflets cover the main points of the spray operations with a detailed description of the techniques that were used for each step. Despite their frequent reference to the use of *B.t.* for spruce budworm control, they can be easily modified for other private woodlot protection programs. For example, they could be used to develop a protection program for woodlots infested by the gypsy moth or serve as a basis to develop spruce budworm control programs using other types of aircraft and pesticides.

The technology described herein is not limitative and other organizations have used different technologies with success. However, the protection program of private woodlots in eastern Quebec, as a whole, was an unprecedented initiative and the technology used for its realization was tested in the field and is operational.

The document "A review of aerial spraying technology for spruce budworm control in private woodlots in eastern Quebec" is intended as a simple and efficient reference to assist you in developing protection programs corresponding to your specific needs.

TECHNICAL LEAFLET 1

SELECTING STANDS TO BE TREATED

1. IDENTIFYING SOFTWOOD STANDS

2. DETERMINING SPRAY BLOCKS

3. OBSERVING SPRAY BLOCKS
    3.1 Aerial observation
    3.2 Ground observation

4. FORECASTING CURRENT YEAR GROWTH DEFOLIATION

5. GLOBAL EVALUATION AND SELECTION OF SPRAY BLOCKS

REFERENCES

APPENDIXES

MATERIAL REQUIRED FOR THIS PHASE OF THE PROTECTION PROGRAM

SCHEDULE OF ACTIVITIES

1. IDENTIFYING SOFTWOOD STANDS

All adjoining softwood stands of a certain size and susceptible to being treated were identified the summer before the treatment year. The softwood stands (Figure 1) were first located on forest maps of the territory under study. These forest maps and recent aerial photographs (1:15 000) were then studied using a stereoscope to obtain a more precise picture of the softwood stands and the mixed stands with softwood dominance to be protected (Figures 1 and 2).

2. DETERMINING SPRAY BLOCKS

Following this first step, spray block limits were charted on these maps. Areas to be sprayed were planned in the form of blocks in order to facilitate field and aerial operations. Roads, clear cuttings, and lot boundaries were used to trace the block boundaries and obtain adequate shapes (rectangular blocks being advisable). Also, topography or stand feature was a major factor in tracing block boundaries and blocks representing high risks (abrupt cliffs, succession of valleys and cliffs) for safe aircraft operations, and thus having little chance of yielding the expected results, were partially or completely eliminated.

The area of each block to be treated is another important factor to consider when selecting blocks. It is almost impossible to determine a minimum and a maximum size of blocks because this will be determined by various elements such as the financial resources available, the total area to be treated, and the spraying technique used.

The profitability of each block must be determined. For example, to carry out an economical and efficient operational program with a Grumman AgCat, 600 HP or 450 HP, we considered that the blocks must be over 100 ha in area, although AgCats may be used for smaller blocks. It should be remembered, however, that the smaller the block, the higher the cost. This is because numerous turns are required, time is lost by moving from flight line to flight line, and there are higher risks of error.

3. OBSERVING SPRAY BLOCKS

Visual observation to assess the condition of the blocks retained after the first two phases of planning, is considered to be an essential phase in selecting blocks to be sprayed. During these site verifications, several parameters should be evaluated. One such parameter is the condition of the roads and any change in their layout as this is important for planning spray paths. Then, any newly cut sites that do not appear on the aerial photographs being used must be indicated. If there are several newly cut areas, the entire spray block, or part of it, may be eliminated. To avoid unnecessary field trips, check the potential and planned logging operations with owners or managers of large private woodlots.

Finally, in our case, it was necessary to determine the spruce (*Picea glauca* (Moench)) and fir (*Abies balsamea* (L.) Mill.) mortality resulting from past spruce budworm attacks. A minimum volume of living spruce and fir to be protected was established, which allowed better planning and a more profitable return from the protection program.

Two methods are suggested for observing spray blocks: aerial observation or field visits. Recent black and white and infrared aerial photographs can also make surveying the blocks easier.

3.1 Aerial observation

Aerial observation is the fastest and most efficient way to conduct a first survey. It gives a general view of the spray blocks and allows recent cuttings and new forest roads to be outlined on maps and aerial photographs. Two types of aircraft can be used: fixed-wing aircraft or helicopters. Helicopters, although slower than fixed-wing aircraft, are more versatile. They are able to move slowly and lower over the area to be surveyed and they are not dependant on landing strips. Their sole disadvantage is the higher rental cost. However, this difference may be minimized when it is considered that more flying time will be needed to conduct a similar survey using fixed wing aircraft.

Figure 1.
This type of forest map (1:20 000) may be used to select spray blocks.

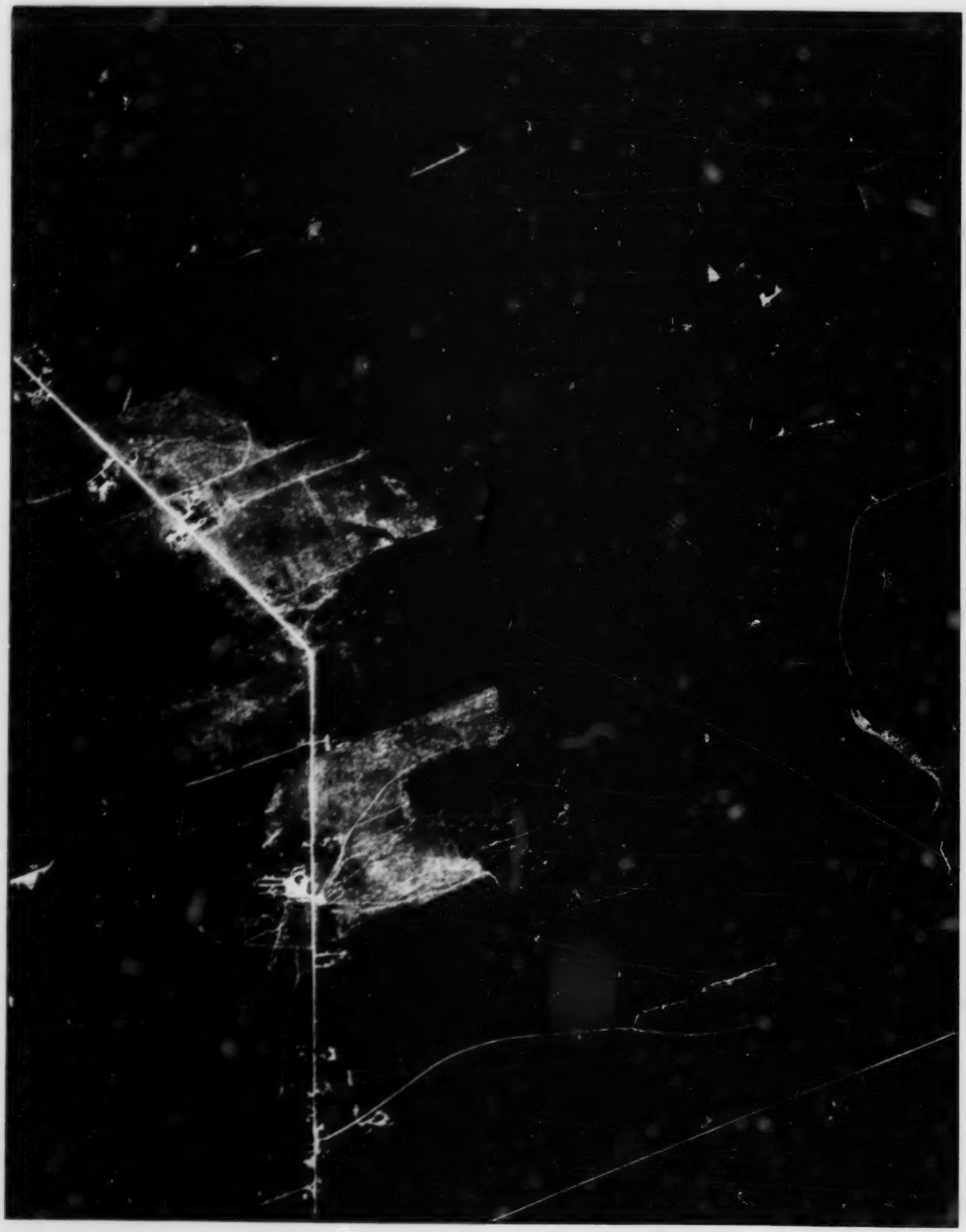


Figure 2.
Aerial photograph (1:15 000) used to select spray blocks.

Several types of helicopters and fixed-wing aircraft can be used. Helicopters should provide maximum visibility and long autonomy (Figure 3). Fixed-wing aircraft should have the ability to fly low and have above-cabin mounted wings (for example, the Cessnas and Beavers) (Figure 4).

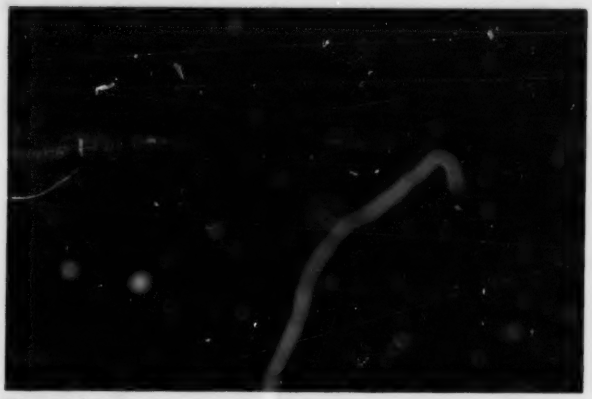


Figure 3.
Hughes 500-C helicopter used to survey the territory.

Figure 4.
Aircraft used for surveying potential spray blocks.

3.2 Ground observation

Ground observation is recommended for a spraying operation covering less than 5000 ha and where the individual blocks do not exceed 500 ha. With spray blocks larger than 500 ha, it was felt that the person per hour time required is too high making this method more expensive than aerial observation, especially in blocks with poor accessibility.

Ground or aerial observations are of utmost importance when planning a spray program in private woodlots. It must be remembered that woodlot owners or managers may have recently modified the character of the stand by annual cuttings.

4. FORECASTING CURRENT YEAR GROWTH DEFOLIATION

Defoliation for the following year is estimated by counting egg masses or determining the level of overwintering larval populations (L_2) (treatment of branches in sodium hydroxide solution). Both are proven and recognized methods, however the latter is more frequently used. As both methods are described in detail in Technical Leaflet 5, only a brief outline is given here. The first method determines the number of egg masses per 10 m^2 of foliage (Morris 1954). These figures are applied to a sequential count to give defoliation risk indexes. The second method evaluates the defoliation risks by calculating the number of overwintering larvae (L_2) per 10 m^2 of foliage (Miller et al. 1971). Each manager or woodlot owner should use the method that best corresponds to his facilities. When physical facilities exist and funds permit, an overwintering larva count is suggested. Rather than using the two methods with a limited number of samples, the number of samples can be increased by using only one method. This extra data may help to reinforce the decision to reject or keep a block for treatment.

In addition, current year growth defoliation for the past 3 years was estimated using Fettes (1950) method, also described in Technical Leaflet 5, in order to evaluate the vigor of trees to be protected.

5. GLOBAL EVALUATION AND SELECTION OF SPRAY BLOCKS

A detailed analysis of the results obtained during the preceding steps served to determine the spray areas the following spring. The selection of spray blocks was not always easy because contradictory results were often encountered within the same block. For example, results from a sample plot would indicate low defoliation the following season, whereas results from another plot in the same block would indicate severe defoliation. In these circumstances, the defoliation that occurred during the past 3 years was used to support the decision of retaining or rejecting a block. In addition, more samples were collected from these blocks. When results of sampling remained variable, the block or part of the block was rejected or revalidated in the spring. A diagram of the process used for establishing blocks is illustrated in Appendix I.

The selected blocks were classified by order of importance using the following parameters:

(1) index of defoliation risk (larval population);

(2) forest composition (volume of spruce and fir);

(3) tree condition (current year growth defoliation); and

(4) block accessibility.

Block classification was established in case it was necessary to withdraw some blocks from the program due to operational problems during spraying. Weather conditions or technical problems can shorten the treatment period, which is already very short, and force the spray program manager to delete certain blocks from the program. Finally, estimating the number of insects in the spring was the ultimate criteria used to confirm a spray block in our treatment program.

REFERENCES

Fettes, J.J. 1950. Investigations of sampling techniques for population studies of the spruce budworm on balsam fir in Ontario. *In* Can. For. Serv. Annu. Rep., For. Ins. Lab., Sault Ste. Marie, Ontario.

Miller, C.A., Kettela, E.G.; McDougall, G.A. 1971. A sampling technique for overwintering spruce budworm and its applicability to population surveys. Can. For. Serv., Maritimes For. Res. Cent., Fredericton, N.B. Inf. Rep. M-X-25.

Morris, R.F. 1954. A sequential sampling technique for spruce budworm egg surveys. Can. J. Zool. 32: 302-313.

Service canadien des forêts. 1986. Programme de pulvérisation aérienne de *Bacillus thuringiensis* en forêt privée dans l'est du Québec. Proposition pour 1987. OPB de La Pocatière, SPB de la Gaspésie, SPB du Bas Saint-Laurent en collaboration avec le Service canadien des forêts. Serv. can. forêts, Développement forestier, Cent. for. Laurentides, Sainte-Foy, Québec.

MATERIAL REQUIRED FOR THIS PHASE OF THE PROTECTION PROGRAM

Uses	**Material specifications**	**Suppliers**
Spray block selection	Forest maps & aerial photographs	Department of Energy and Resources, Quebec
	Survey maps	Energy, Mines and Resources Canada
Aerial Survey	Hughes 500-C helicopter	Licenced aircraft rental services
	Hughes 300-C helicopter	Licenced aircraft rental services

SCHEDULE OF ACTIVITIES

1. Identifying softwood stands:
   end of August to October

2. Selecting spray blocks:
   end of August to October

3. Surveying spray blocks:
   September, October and May of the following year

4. Forecasting defoliation risks:
   September and October

5. Global evaluation and selection of spray blocks:
   October and November

TECHNICAL LEAFLET 2

ENVIRONMENTAL AND SOCIAL CONCERNS OF AERIAL SPRAYING FOR SPRUCE BUDWORM CONTROL

1. ENVIRONMENTAL REGULATIONS
    - 1.1 Provincial governments
    - 1.2 Federal government
2. INFORMING WOODLOT OWNERS
    - 2.1 Pretreatment
    - 2.2 Treatment
    - 2.3 Posttreatment
3. INFORMING THE GENERAL PUBLIC
    - 3.1 Pretreatment
    - 3.2 Treatment
    - 3.3 Posttreatment
4. INFORMING OTHER ORGANIZATIONS

MATERIAL REQUIRED FOR THIS PHASE OF THE PROTECTION PROGRAM

SCHEDULE OF ACTIVITIES

1. ENVIRONMENTAL REGULATIONS

All aerial spray programs are subject to strict provincial and federal regulations and these regulations differ for each province.

1.1 Provincial governments

The following is a partial listing of the laws and regulations of each province, along with examples of actions taken in Quebec. This partial listing covers the laws and regulations for a spray operation similar to that described in the present technical leaflets. The organizations identified will be able to provide you with additional information on other laws or regulations that may apply to your spray operation. The listing presented below dates to 1984 and it is based on the document "Pesticide Legislation in Canada 3rd Edition" compiled by Agriculture Canada. Therefore, it is advisable to contact the concerned authorities in each province or territory before planning an aerial application of a pesticide.

Alberta:
"Agriculture Chemicals Act"

This Act prescribes the proper use of pesticides and fertilizers in accordance with the Pest Control Products (PCP) Act (Canada), the Fertilizers Act (Canada), and the label instructions of the manufacturer. The Act deals with safe use, application, handling, storage, maintenance, transportation and disposal. Human food, animal feed or other matter contaminated by a pesticide may be restricted or destroyed by order of the Minister without compensation therefore. Use and application may be suspended or terminated by order of the Minister or an inspector. A regulations section allows for the passing of regulations by Order in Council respecting any matters concerning pesticides or fertilizers.

Administered by: Department of the Environment
Pollution Control Division
Pesticide Chemicals Branch
9820-106 Street
Edmonton, Alberta

"Regulations Respecting the Sale, Use and Handling of Pesticide Chemicals"

This regulation provides restrictions for handling pesticides on public land such as grazing, forested, and open-water areas. It also provides precautions and proper directions for handling structural extermination with fumigants. Conditions for transportation, storage, display, and disposal of pesticide chemicals are included. In addition, the use of certain chlorinated hydrocarbons is restricted and other highly hazardous pesticides are prohibited, except under permit or in accordance with the Agricultural Pest Act.

The regulations outline the classification of pesticides and include regulations for licensing of wholesale and retail pesticide vendors.

Administered by: see the Agricultural Chemicals Act.

British Columbia:
"Pesticide Control Act"

This Act provides for the regulation of:

i) the sale of pesticides;

ii) the application of pesticides on a fee-for-service basis; and

iii) the use of pesticides on land in the public domain.

SBC 1977

Administered by: Pesticide Control Branch
British Columbia Ministry of the Environment
810 Blanshard St.
Victoria, B.C.
V8V 1X5

Prince Edward Island:
"The Agricultural Chemicals Act"

This Act provides comprehensive legislation with respect to pesticides, fertilizers, and other chemicals used on agriculture, forest, or provincial lands. Regulations cover the labelling, sale use, disposal and handling of pesticides, and the licensing of pesticide applicators. The Act includes all materials that are registered under the PCP

Act and requires that the terms of the federal Act be met. Application of pesticides is controlled by permits and these may be suspended by appointed inspectors. Pesticide usage in or near any body of water is similarly regulated.

RSPEI 1974 A-4

Administered by: P.E.I. Dept. of Agriculture
& Forestry
P.O. Box 1600
Charlottetown, P.E.I.
C1A 7N3

Manitoba:
"The Pesticide and Fertilizer Control Act"

This Act requires that pesticide dealers and applicators be licensed under the provisions of this Act and keep records on the supply, sale, and use of pesticides so handled. Fertilizers and pesticides classed as "Domestic" under the federal P.C.P. Act are excluded.

SM 1976 c.19

Administered by: Manitoba Department
of Agriculture
9th floor, Norquay Building
401 York Avenue
Winnipeg, Manitoba
R3C 0P8

"The Predator Control Act"

This Act provides that no person shall kill a predator by use of poison or poison baits without written permission of the Minister appointed for the administration of the Act.

RSM 1970 c.P110

Administered by: Department of Natural
Resources
1495 St. James Street
Winnipeg, Manitoba
R3H 0W9

"The Forest Act"

Under Section 43 of this Act, the Minister may make arrangements with federal, provincial, or municipal authorities or the owner or licensee of a forest for the protection of forest resources, including protection from insects and disease.

RSM 1970 c.F150

Administered by: see The Predator Control Act.

"The Clean Environment Act"

This Act provides regulations for controlling the amount of contaminants that may be discharged or emitted into the air, soil, and water. Contaminants are defined as any substance that affects the natural, physical, chemical, or biological quality of the environment.

SM 1972 c.76

Administered by: Environmental Management
Division
Box 7, Building 2
139 Tuxedo Blvd.
Winnipeg, Manitoba
R3N 0H6

New Brunswick:
"Pesticides Control Act"

This Act provides for the use and sale of pesticides. Commercial applicators and retail vendors are licensed to operate in New Brunswick. Permits are required for the commercial application of pesticides. Records are kept by both the applicator and the vendor.

RSNB 1973 c.P-8

Administered by: Director of Pesticides Control
Department of the Environment
P.O. Box 6000
Fredericton, N.B.
E3B 5H1

"The Forest Service Act"

Under this Act, the Minister of Natural Resources may enter into agreement with the Government of Canada or with any person to undertake and carry out operations for protecting forests from fire, insects, and disease.

RSNB 1973 c.F-23

Administered by: Department of Natural
Resources
P.O. Box 6000
Fredericton, N.B.
E3B 5H1

Nova Scotia:
"The Agriculture and Marketing Act"

This Act stipulates that the provincial entomologist may exercise all the powers of an inspector appointed under the Act in the control of plant disease, insects, and other pests. The Act specifically regulates the apple maggot and contagious diseases among bees, e.g. American Foulbrood, European Foulbrood, or Sacbrood disease.

RSNS 1967 c.3

Administered by: Deputy Minister
N.S. Dept. of Agriculture
& Marketing
Hollis Building
P.O. Box 190
Halifax, Nova Scotia
B3J 2M4

"The Health Act"

This Act allows for the control of substances, including pest control products, that could contaminate or be considered a nuisance with respect to human health. Section 11(b) deals specifically with water supplies and section 11(d) is concerned with water pollution. Section 47 is general and is designated to handle instances when a public health nuisance is created. Section 44A is also relevant.

R.S.N.S. 1967 c.247
amended 1968 c. 50
amended 1969 c. 59
amended 1970 c. 62
amended 1973 c. 50

Administered by: Director
Public Health Engineering
Nova Scotia Department
of Health
P.O. Box 488
1690 Hollis Street
Halifax, N.S.
B3J 3J9

"The Environmental Protection Act"

This Act gives the Minister the power to "regulate and control the use, storage and disposal of biocides and chemicals or minerals which may be harmful to man, animals, plant life or natural resources".

SNS 1973 c.6
amended 1975 c.16

Administered by: Chief, Environmental
Development Section
Environmental Assessment
Division
N.S. Dept. of the Environment
P.O. Box 2107
Halifax, Nova Scotia
B3J 3B7

Ontario:
"The Pesticides Act"

This is a comprehensive Act governing the use and sale of pesticidal chemicals designated into classes to be handled by applicators also designated into classes according to their licenses obtained from the department. The whole Act is pertinent and does not permit extermination to be carried out if the product is not registered under the PCP Act or if the recommendations are not on the product label. This Act also controls the discharge of pesticides into Ontario's waters by requiring that all discharging of pesticides into waters with an outflow be done under permit.

RSO 1980 c.376 as amended by 1981 c.51

Regulation 751, revised Regulations of Ontario, 1980 as amended to O. Reg 161/82, O. Reg 70/84

Administered by: Director
Agricultural & Industrial
Chemicals Section
Hazardous Contaminants and
Standards Branch
Ministry of the Environment
40 St. Clair Avenue West
Toronto, Ontario
M4V 1P5

"The Forest Tree Pest Control Act"

Under this Act, the Minister of Natural Resources has the power to appraise and control insect or other pest infestations. Forest tree pests are defined as any vertebrate or invertebrate animal, any virus, fungus or bacterium, any weeds or brush, or other organism that is injurious to forest trees.

RSO 1970 c.180
RSO 1980 c.174

Administered by: Director
Forest Resources Branch
Ministry of Natural Resources
3rd floor
Whitney Block
99 Wellesley Street West
Toronto, Ontario
M7A 1W3

Saskatchewan:
"Pest Control Products (Sask.) Act (1973)"

This Act regulates and controls the use, distribution, and handling of pesticides. It contains prohibitions against:

(1) selling pesticides that do not meet specific standards;

(2) certain uses of pesticides;

(3) discharging pesticides into a body of water without a permit;

(4) disposal of pesticides or containers; and

(5) cleaning pesticide apparatus in an open body of water.

The requirements for persons keeping, storing, or transporting a pesticide are given.

The Minister has the power to restrict or prohibit the use or distribution of any pesticide, fertilizer, feed, animal, plant, water, produce, or other matter considered to be contaminated with a pesticide. Inspectors may be appointed and have the authority to enter upon and inspect any land, premises, or vehicle, with the exception of a principal dwelling place. A search warrant is required to enter a principal dwelling place.

SS 1973 c.72

Administered by: Production and Marketing
Division
Plant Industry Branch
Saskatchewan Agriculture
Room 133, Provincial
Administration Building
Regina, Saskatchewan
S4S 0B1

"The Department of the Environment Act"

This Act establishes the Department of the Environment as the authority to enhance and protect the quality of the environment through regulations controlling the disposal of solid wastes and use of chemicals, including insecticides and herbicides.

SS 1972 c.31

Administered by: Department of Environment
1855 Victoria Avenue
Regina, Saskatchewan
S4P 3T2

Newfoundland:
"The Pesticides Control Act"

This Act provides for the licensing, sale, and use of pesticides. Regulations for the sale, handling, distribution, and disposal of pesticides are provided. Inspectors are appointed and may terminate the method of application or use of pesticides if deemed hazardous to persons, animals, crops, or plant life. Analysis of foods for pesticide contaminants is also provided for. The Lieutenant-Governor in Council may appoint advisory bodies.

SN 1983 c.52

Administered by: The Minister of Environment
P.O. Box 4750
St. John's, Nfld.
A1C 5T7

"The Pesticides Control Act (1983) Regulations"

These regulations are in preparation. Details are available at the Ministry of Environment (address given above).

Administered by: see The Pesticides Control Act

"The Department of Environment Act"

This Act provides controls for pollutants emitted into the air, soil, and water. The Lieutenant-Governor in Council is responsible for formulating regulations to preserve the aesthetic, physical, chemical and biological qualities of the environment.

SN 1981 c.10

Administered by: see The Pesticides Control Act.

"The Environment Assessment Act"

Regulations are in preparation and further details are available at the Ministry of Environment. This Act provides for environmental assessment prior to the approval of certain activities which are defined as *undertakings* by the Minister or by the regulations. Any proposal for aerial application of a pesticide is considered to be an undertaking and, therefore, is subject to registration and review to determine the need for assessment.

SN 1980 c.3

Administered by: see The Pesticides Control Act

Yukon Territory:
"The Public Health Ordinance"

This Ordinance regulates the use of noxious materials dangerous to public health, protects persons whose occupation may expose them to substances that may be injurious to their health, prohibits pollution of any body of water, and regulates the use of substances such as insecticides or rodenticides. It also provides for licensing and regulation of persons engaged in vermin or rodent extermination.

Administered by: Yukon Health Services
Government of Yukon
Box 2703
Whitehorse, Yukon
Y1A 2C6

"The Forest Protection Ordinance"

This Ordinance prescribes procedures to be followed to protect forest resources from injurious insects and diseases.

ROYT 1971 c.F-9

Administered by: Forest Resources Division
Northern Renewable Resources Branch
Dept. of Indian and Northern Affairs
Hull, Quebec
K1A 0H4

Northwest Territories:
"Pesticide Ordinance"

This Ordinance regulates the use, storage, and disposal of pesticides. The Ordinance permits the application of pesticides by permit only and the Commissioner establishes the qualifications and conditions that must exist before a permit is issued.

RO 1970 c.17

Administered by: Chief, Pollution Control Division
Department of Renewable Resources
Government of the Northwest Territories
Yellowknife, N.W.T.
X1A 2L9

Quebec:
"The Environment Quality Act"

This Act provides for the control of contaminants that may alter or be prejudicial to the quality of the environment in any way. Regulations concerning vendors and users are in preparation.

RSQ, c.Q-2
amended 1974 c-51

Administered by: Quebec Department of the Environment
3900 Marly
Sainte-Foy, Quebec
G1X 4B1

General Regulation Relating to the Administration of the Environmental Quality Act

This regulation stipulates that a permit is compulsory for the following uses:

i) spraying pesticides on transportation and energy rights-of-way;

ii) use of nonregistered products under the Pest Control Products Act (RSC 1970 c.P-10);

iii) nonagricultural aerial spraying of pesticides; and

iv) use of pesticides in an aquatic medium with surface outflow to a drainage basin.

Reg. 75-430 Aug. 15, 1979
Amended 3734-80 Dec. 3, 1980

Administered by: see The Environment Quality Act

In Quebec, the Department of the Environment (DOEQ) is responsible for assuring the protection of the environment and establishing the criteria for aerial spraying of pesticides.

The DOEQ assumes its responsibilities through paragraph 22 of the Environment Quality Act which requires that each owner or manager (executing organization) prepare a detailed description of their spray program. Depending on the size of the proposed program, the DOEQ may require either an authorization certificate or an impact study complemented with public hearings.

For our spray program in private woodlots in eastern Quebec, it was sufficient for each owner to sign an application to the DOEQ for a certificate of authorization. This signed application confirmed the owner's participation in the program and also identified the owner as the executing agent of the treatment program for his woodlot.

The following information is given on the said application form: the woodlot owner or manager's name and address, name of organization responsible for the program realization, project title, location of the lots to be sprayed, reasons behind the proposal, operation schedule, insecticide to be used and other technical details on the program (Appendix 1). These details have to be described in a document, called the "supporting report", addressed to the Department of the Environment. Also, the supporting report must include maps of the "Municipalités régionales de comté" (MRC), at a scale of 1:50 000 showing spray blocks, bases (airfields), safe flight routes, and environmentally fragile areas (pisiculture, beehives, deer and moose feeding sites, and drinking water watersheds) (Figure 1). The above-described procedure is only accepted for programs with an area of 600 ha or less per owner. In cases where the area exceeds 600 ha per owner, an environmental impact study is required to obtain the necessary authorization for spraying, and the Department of the Environment may require public hearings.

After its analysis of the project, the Department of the Environment issues authorization certificates for each lot found safe for spraying. Authorization certificates are accompanied by a list of requirements that have to be followed during the course of the program. As mentioned above, these requirements are not as strict as those required for chemical spraying. To illustrate this, Appendix 2 reports the requirements accompanying the 1985 authorization certificates. These requirements are subject to periodical revision and thus may change every year.

Representatives from the Department of the Environment supervise the operations to assure that requirements are strictly followed, both at the bases and in the field. Finally, the executing organizations have to present a final report to the Department of the Environment describing the spraying operations, difficulties encountered, and the measures taken to overcome them. The document must also report the results obtained.

1.2 Federal Government

The Eastern Quebec Development Plan forest program is subject to the Federal Environmental Assessment and Review Process (FEARP) because it is a federal program. The regulations behind the FEARP have been described in the Privy Council #2131 decree emitted as part of the Government Organization Act (1979) and published in the Canada Gazette, part II, dated July 11, 1984 (Appendix 3).

This review is an auto-evaluation that permits the Minister in charge to examine, during the initial planning phase and before taking any irrevocable decision, the potential environmental effects of each proposition upon which he has the power to make a decision. The federal organization or department in charge of the project should

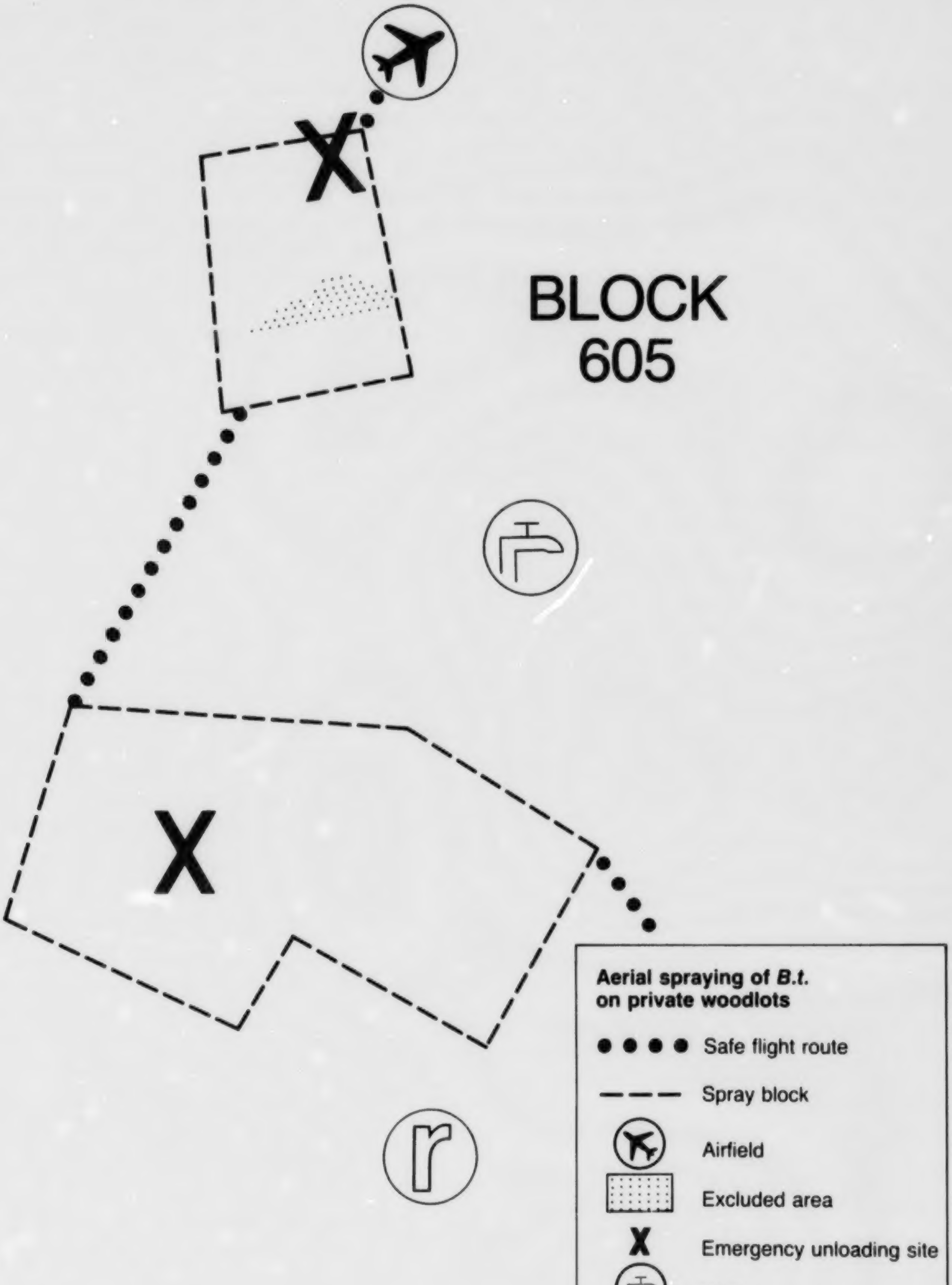

BLOCK
605
Aerial spraying of B.t. on private woodlots
● ● ● ● Safe flight route
– – – Spray block
Airfield
Excluded area
X Emergency unloading site
Well
Beehives

Figure 1.
Map to accompany the document submitted to the appropriate departments to obtain the authorization certificates required.

provide the following details: project definition, magnitude of the potential effects, the cumulative factor of the effects (if any), duration and frequency of the proposed activity, the hazard involved, the value of the site of possible impact, and the potential means of correction.

Documents prepared to meet provincial regulations may also meet federal ones or vice-versa, depending on the province where the operation is to be carried out.

2. INFORMING WOODLOT OWNERS

This phase was aimed at informing potential users of the program. Information on the program was distributed prior to spraying to obtain the woodlot owner's approbation, during the spraying operation to inform them of its progress, and after the operation to announce the results.

2.1 Pretreatment

In February, prior to treatment, a list of woodlot owners was drawn up from municipal registers and compared to areas selected for treatment that had been outlined on sector maps. This information listed the owners in two groups (Appendix 4): one by order of property lot number and the other in alphabetical order. When necessary, it was possible to trace a property owner quickly using this double classification.

Various types of woodlots were identified during this pretreatment phase. The types existing in Quebec are too numerous to list here. However, all types of private woodlots have the potential to benefit from an aerial spray program. Those in charge of the program first identified the criteria and then obtained permission to spray from the owners or managers. In order to help you define your criteria, those used for the aerial spraying of *B.t.* in eastern Quebec are listed in Appendix 5.

Owners were then grouped in two categories: those living directly within the areas to be treated (or in the immediate vicinity) and those who lived in other regions. The technical staff of the executing organization organized meetings for those living in areas to be treated or in their vicinity. Depending on the number of woodlot owners, meetings were organized in different localities covered by the program. Through audio-videos, videos, and slides, these meetings assured rapid and efficient diffusion of information by the technical team and resource personnel of the wood producers' associations. Also, maps showing the woodlots were available for consultation. This enabled each woodlot owner to visualize the location of the lots to be sprayed. Due to the cost and time involved in preparing these meetings, they were generally held for 25 persons or more. To assure maximum participation in these meetings, the following steps were taken:

1- an invitation was mailed 4 to 5 days before the meeting (Appendix 6);

2- all those invited were called the day before the meeting;

3- meetings were not organized on days of major social, cultural, or sports events; and

4- meetings were scheduled at the beginning of the week when possible.

During these meetings:

1- professional and technical staff responsible for the program, and participants and advisers to the program were introduced;

2- the project and project schedule, with references to past operations where applicable, were presented;

3- operational details (aircraft, insecticide, mixing facilities, insects) were described, with the use of visual aids when possible;

4- the two forms to be signed by the owners were explained (the agreement between the owner and the wood producers' associations, and the application to the DOEQ for authorization certificates);

5- a question period was held; and

6- there was a final wrap-up of information and interested owners signed the necessary forms.

The fourth item is very important because the owners' signatures are required for the spray program to be carried out. The application for a certificate of authorization was discussed in section 1.1 and is presented in Appendix 1.

The agreement specifies the owner's and wood producers associations' responsibilities, respectively (Appendix 7).

Following these meetings, those who did not attend were contacted individually by the field teams in order to transmit the information and obtain the necessary signatures.

The procedure used for woodlot owners living outside of the area to be treated was as follows: first, they were contacted by telephone; then they were sent an information leaflet along with the two forms to be signed and a self-addressed return envelope. If these owners had not returned their forms within a few weeks, they were contacted again by telephone. Some owners did not participate in the protection program. Therefore, it was necessary to exclude some sections of blocks, provided that it was feasible to treat the remaining sections. When it was impossible to do so, the entire block was deleted from the spray program.

2.2 Treatment

During the spraying, several methods were used to keep the woodlot owners informed. As we will see in section 3, radio and local newspapers were the main avenues for transmitting information. The use of these medias made it possible to reach the general public as well. To respond to individual enquiries from owners or the general public, a 24-hour a day, 7-day a week telephone service was maintained for the duration of the treatment program. Also, those in charge of the operation were responsible for informing owners who had specifically requested it, of the exact date that the operation would begin on their woodlot.

2.3 Posttreatment

Two types of posttreatment information were released. One for owners whose lots had been treated and one for owners whose lots had not been treated. The latter received a letter stating the main reasons why their lots were not treated (Appendix 8). This letter was sent as soon as possible after the treatment was completed, that is at the end of June.

Owners whose woodlots were treated received a letter, a survey map (1:50 000) (Appendix 9), and an information sheet indicating: owners' names and addresses, location of their lots, numbers of the blocks where their lots are located, results (larval mortality and current year growth defoliation), and the name and phone number of the person in charge of the area. Because this letter contained the final results of the spray program, it was sent in the fall.

3. INFORMING THE GENERAL PUBLIC

An essential phase of any spray program is to release general information to the public. Various forms of communications were used to inform people before, during, and after the treatment period.

3.1 Pretreatment

A press release was transmitted to local newspapers and radio stations serving the population in and around the areas to be treated (Appendix 10). This press release contained the following information: names of executing and sponsoring organizations, areas to be treated, insecticide to be used, cost, and other pertinent information. This first press release announced the project and was transmitted to the medias by the end of April.

About one or two weeks prior to spraying, an announcement (Appendix 11) indicating the executing organization, the participants, the areas to be treated, the method of treatment, the insecticide to be used, the periods of spraying, and the reasons for treatment was published in local and regional newspapers. This also served as an opportunity to inform the public of the telephone number to call for additional information.

In some circumstances, the pretreatment communications were transmitted by holding a press conference complemented with demonstrations of the spraying operation. The regional media representatives were invited to these conferences which were aimed at answering their questions and demonstrating the flexibility of the aircraft, the safety of the operations, and the minimal volume of material dispersed.

3.2 Treatment

During treatment, those concerned were kept informed daily of the progress of the operation. Messages were transmitted by local radio stations indicating the specific areas to be treated within 24 to 72 hours (Appendix 12). These messages were transmitted at different periods during the day in order to reach the maximum number of listeners.

3.3 Posttreatment

A final press release was transmitted to the same medias after the operation was completed. This release specified: the names of executing organizations and participants, areas treated, number of owners implicated, and other details of general interest (Appendix 13). This information was released in August. Due to the magnitude of this diffusion and the variety of the population to be reached, a general assessment of the program was given at this time rather than detailed results of larval mortality or defoliation.

4. INFORMING OTHER ORGANIZATIONS

Several public, para-public, and private organizations are involved in private woodlot management. Those directly involved as owners or managers of private woodlots were informed according to the process described in section 2.

Other organizations, which are indirectly involved, were sent a letter informing them of the general aspect of the program (Appendix 14). These organizations were municipalities, forest protection societies, and departments responsible for activities related to forestry such as wildlife, fish, and game. More detailed information such as maps, reports, and details of the operation were sent to the provincial authorities responsible for forest management, given their participation in similar spray programs in public forests.

MATERIAL REQUIRED FOR THIS PHASE OF THE PROTECTION PROGRAM

Uses	Material specifications	Suppliers
Owner's identification	Land register maps: 1:20 000	Local or regional map library
Group meetings	Meeting room, maps of blocks, slide projector, information leaflets, pre-identified forms, extension wire, tape, and ballpoint pens	Local suppliers Municipalities

SCHEDULE OF ACTIVITIES

1. Environmental regulations

   Federal and provincial: March and April

2. Informing woodlot owners
   - 2.1 Pretreatment: February to mid-April
   - 2.2 Treatment: end of May to mid-June
   - 2.3 Posttreatment:
     - — owners of untreated properties: July
     - — owners of treated properties: August and September

3. Informing the general public
   - 3.1 Pretreatment: end of May to the beginning of June
   - 3.2 Treatment: radio spots 48 hours before treatment and continuing until the end of the treatment period on designated blocks
   - 3.3 Posttreatment: September

4. Informing other organizations: April and May

TECHNICAL LEAFLET 3

GUIDANCE SYSTEMS

1. GUIDANCE SYSTEMS
    1.1 Ground indicators
    1.2 Aerial guidance
        1.2.1. Preparation
        1.2.2. Execution

MATERIAL REQUIRED FOR THIS PHASE OF THE PROTECTION PROGRAM

SCHEDULE OF ACTIVITIES

1. GUIDANCE SYSTEMS

Setting up aircraft guidance systems is a very important operational phase that is aimed at assuring precision of aerial dispersions. Essentially, it consists of guiding aircrafts with the use of ground indicators or aerial guidance systems. For our operations, the choice of one or the other of these two methods was dictated by the characteristics of the sites to be treated.

In addition to preventing swath overlap, our guidance systems prevented spraying environmentally protected areas (such as lakes and rivers) or woodlots that were not part of the program.

1.1 Ground indicators

Fixed helium-inflated balloons (FB) were used to mark blocks or block sections. These balloons were fixed at each corner where natural obstacles such as clear cuttings, fields or hills could not be used as indicators. To guide aircraft on their flight lines, one or more mobile balloons (MB) were also moved in parallel. This technique was used on relatively flat areas where spray blocks were easily accessible. It was also used to increase the precision of dispersion in certain zones with aerial guidance systems. Generally, the precision obtained using ground indicators was superior to that resulting from aerial navigation.

Planning for the ground indicator method started in March or April. A first draft of the flight lines was drawn on survey maps (1:50 000) with information obtained from forest maps and aerial photographs of the territory. The following points were considered when establishing flight simulations:

- whenever possible, north-south flight lines (FL) were used to prevent the pilots from being blinded by the sun at sunrise or sunset;
- the longest flight lines possible (maximum 5 km) between two indicator balloons were used to reduce the number of turns made by the aircraft;
- the treated areas were subdivided into subsections, each one corresponding to an aircraft load. For example, for a 750 L capacity aircraft with a spray rate of 2.5 L/ha, the subsection had a maximum area of 300 ha (750 L ÷ 2.5 L/ha = 300 ha);
- a minimum number of balloons was used for guidance to avoid the possibility of confusing the pilots; and
- natural or physical obstacles such as montains, valleys, and power lines were given special attention.

The success of the ground guidance system depends on the accurate choice of the mobile balloon lines (MBL). To succeed in this first step, our planning started by identifying roads, forest roads, lot boundaries, pathways, and clear cuttings susceptible to being used as MBLs with the above-mentioned parameters in mind. The MBL should meet the following criteria:

- have a minimum width of 3 m;
- be located at the edge of blocks or block subsections; and
- be relatively straight.

Figures 1 and 2 will allow a better understanding of this operational phase. The block in Figure 1 has an area of 1800 ha. As spraying was carried out by two AgCat aircraft, the block was divided into three subsections: A, B, and C, each corresponding to the capacity load of the aircraft. These subdivisions permitted displacement of the field staff while the aircraft were reloading at the base. Whenever possible, to keep field workers to a minimum, subdivisions were planned taking into account both aircraft capacity load and field staff displacement. This meant that some subdivisions were smaller than aircraft capacity load, but they corresponded to field staff displacement.

To subdivide the above-mentioned block into three sections, all possible MBLs were considered and the best choice made. The pattern outlined in Figure 1 appears to be the most advantageous, although flight lines were not on a perfect north-south axis. The guidance system in subsection A was composed of two MBLs and two FBs. MBL 1 met the three above-mentioned conditions while MBL 2 was straight and wide but located at 900 m from the subsection edge, thus requiring FB 1 and 2.

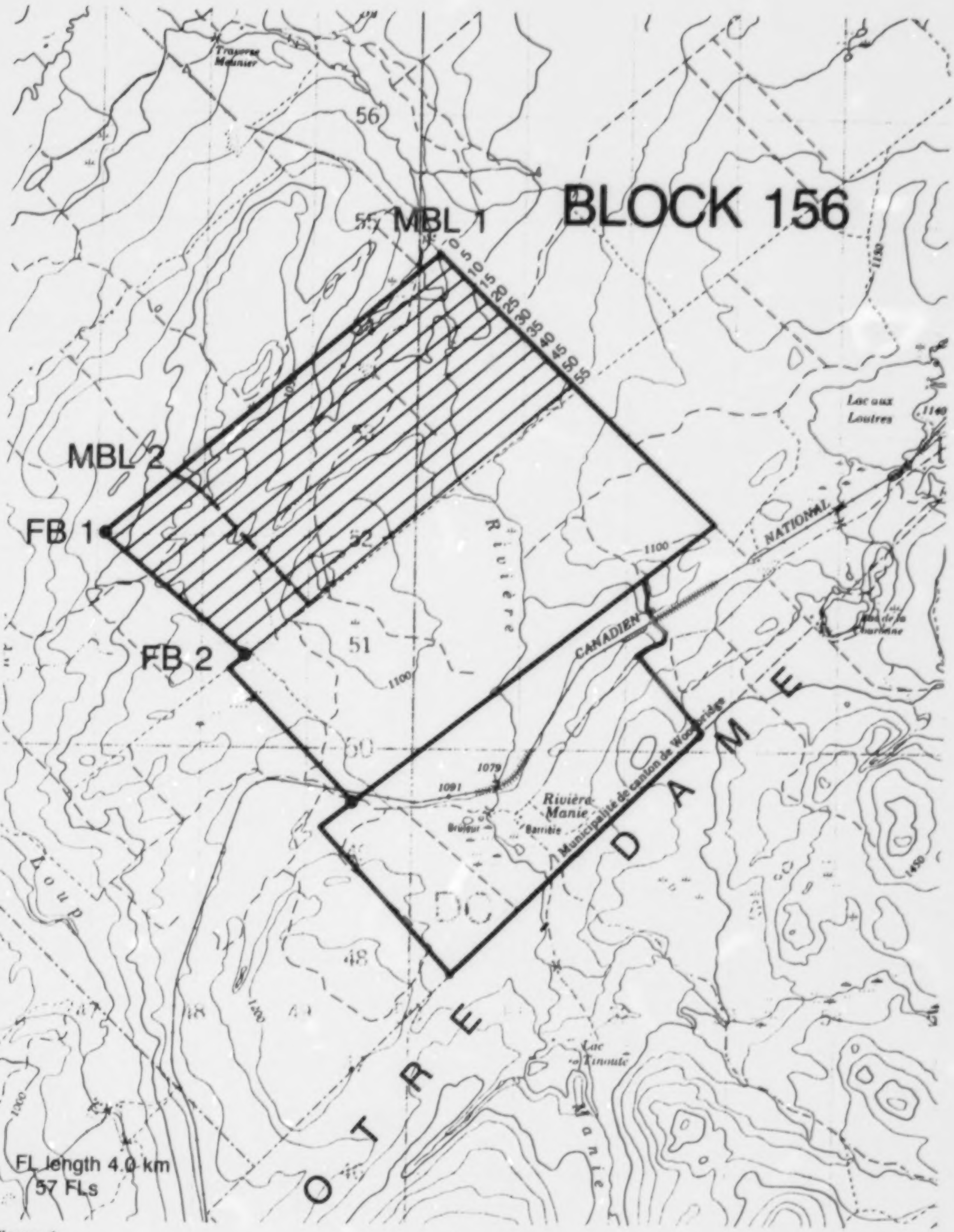

BLOCK 156
MBL 1
MBL 2
FB 1
FB 2
0
5
10
15
20
25
30
35
40
45
50
55
FL length 4.0 km
57 FLs
Lac aux Loutres
NATIONAL
CANADIEN
Rivière
Rivière Manie
Municipalité de canton de Woodbridge
Lac Tinoute
Manie
Loup
N O T R E D A M E
56
55
52
51
60
48
DC
1100
1079
1091
1130
1140
1450

Figure 1.
Survey map showing a guidance system pattern on a spray block.

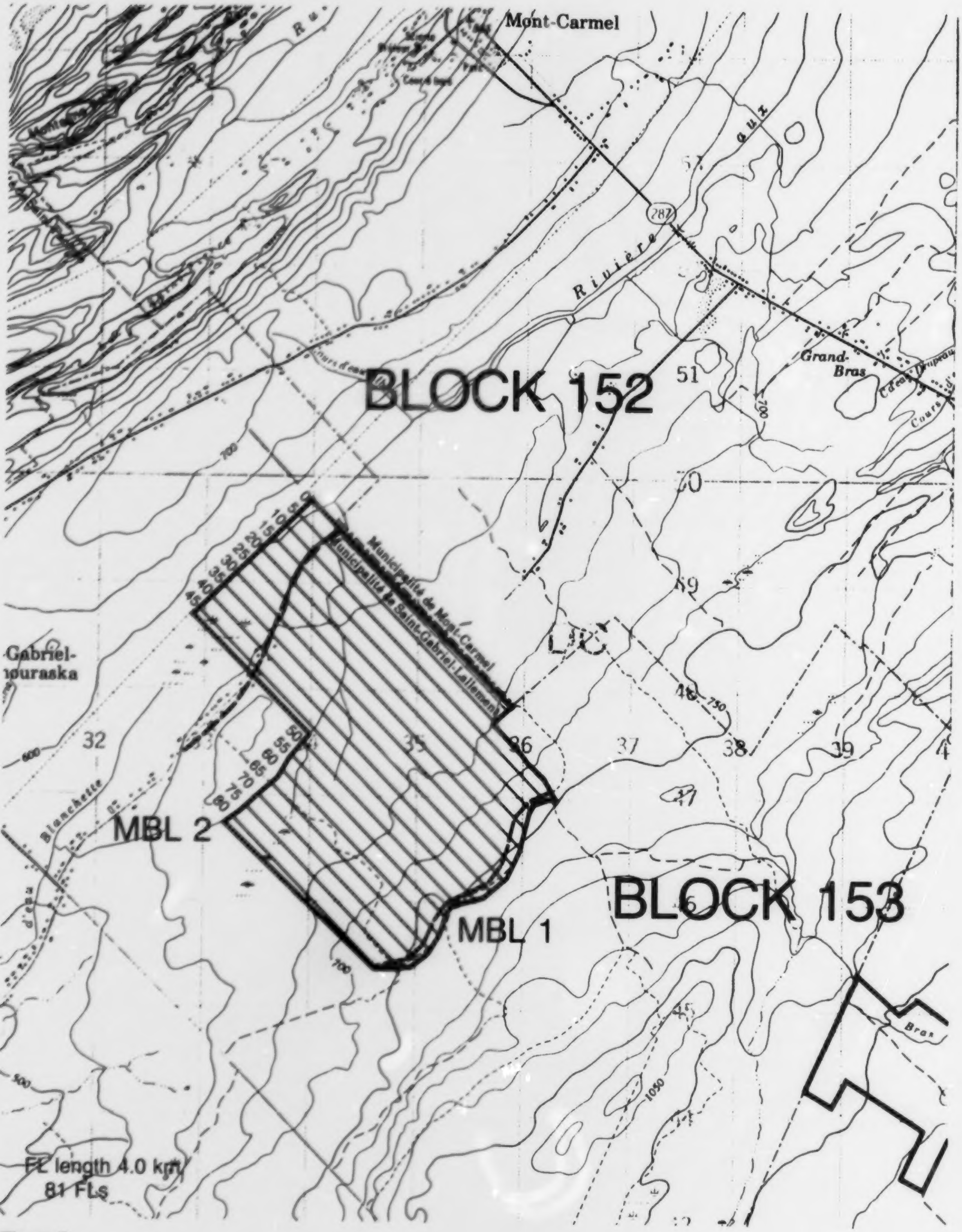

Mont-Carmel
Rivière aux
287
Grand-Bras
BLOCK 152
51
700
Gabriel-
ouraska
Municipalité de Mont-Carmel
Municipalité de Saint-Gabriel-Lallement
32
35
36
37
38
39
MBL 2
MBL 1
BLOCK 153
600
500
1050
FL length 4.0 km
81 FLs

Figure 2.
Survey map showing a guidance system pattern on a spray block.

Following this, flight lines were indicated on a map in order to determine their number and direction. The survey map's scale of 1:50 000 did not permit us to indicate all flight lines, therefore each pen line corresponds to 5 flight lines.

In Figure 2, although the block is 740 ha, it was not subdivided because the two MBLs did not require field staff displacement. Moreover, FBs were not required; MBL 1 was located at the southeast edge of the block and the northwest end was limited by an unforested area. However, the obtacles involved in choosing the MBL were different than in the previous case. This latter MBL 1 had a minimum width for a good operation and both MBLs were rather curved in some sections. To overcome this situation and prevent swath overlap, a correction was effected as if the MBL were straight. Therefore, considering that the swath width was 30 m, the distance between two flight lines was corrected based on the angle given by a theoretical perpendicular line and the MBL (Figure 3).

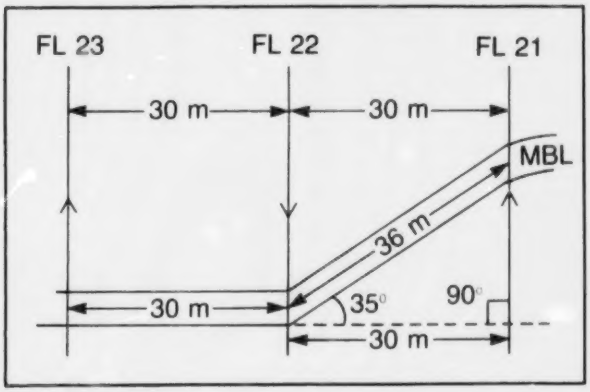


Figure 3.
Evaluating distance between flight lines on roads which are not perpendicular to flight lines.

Another situation is illustrated in Figure 2. From flight line 46 to the end, MBL 2 was located outside the block. No special measures were used to overcome this since examination of aerial photographs indicated a hay field at the limits of this section of the block. In this case, as in all similar cases, the pilots were informed to stop spraying at the edge of the forest. However, if it had been forest that was to be left untreated instead of a hay field, two FBs would have been required (FLs 45 and 80).

After planning the guidance system for the whole program, the material required for the operation was determined. Opaque white and red or orange balloons were ordered from specialized suppliers. White balloons were used as indicators over areas to be treated, while red or orange balloons indicated the areas that should not be treated such as woodlots for which no authorization was obtained or environmentally fragile areas such as lakes, rivers, and drinking water sources. To be easily visible, balloons had a minimum diameter of 76 cm. The next step was to order tanks of helium and flow regulators. Two types of gas tanks were required, small ones (type D, 0.5 m^3) for areas where access was difficult and larger, more economical ones (type T, 8 m^3) for general use. It was very important to order a sufficient quantity of balloons and helium because both were the basic elements of ground guidance systems and the suppliers were generally located far from operation sites. It is more economical to order slightly more material than required than to have to delay the operations for a few days due to a lack of supplies. The remaining material was readily available locally.

A last phase of planning was required before setting up the FBs and the MBLs in the field indicated on the survey maps. It involved meeting with the representatives and pilots of the company contracted to spray. The proposed guidance system was discussed and, if required, corrections were made. Airfield locations, properties of the chosen insecticide, and mixing facilities were also discussed.

At the end of April or as soon as the snow melted enough to provide access to the blocks, they were visited to check some of the points raised during planning. This operation was carried out by one or more technical teams, depending on the size of the program and the time available.

Implementation started by evaluating the MBLs chosen and the potential problems. When the problems were major, such as too narrow or hilly flight lines, the strategy was modified or changed. Careful planning limited changes or made them unnecessary. Often, clearing along the lines was sufficient to facilitate field workers' access to these lines. The narrower the MBL, the greater the risk of balloon breakage.

The MBLs were then numbered using flagging tape attached to trees and identified according to the direction and swath width. For a 30-m swath, the first line was 15 m inside the spray block limit and the others at intervals of 30 m beginning from this line. Even with several aircraft in the formation, all flight lines were identified in the field in case the number of aircraft had to be modified. As MBLs were generally located along public roads, the flagging tape was fixed at the latest possible moment prior to spraying in order to prevent the tape from being removed by persons using these roads.

The pathways to reach the FB tie sites were cleared and identified with flagging tape. This provided easy and rapid access to the sites. This was very important because circulation on these paths usually took place in partial or full darkness. The sites where balloons were fixed were clearly identified by marking stones or tree trunks with fluorescent paint. To determine the number of workers required, the time it took to reach FB sites and set up the balloons was recorded. Figure 1 shows the time required for a worker to leave MBL 2 and reach FB 1. This is important when evaluating personnel requirements and when the time available to prepare a block is limited.

Final preparations consisted of constructing racks to hold the helium tanks in vehicles and ordering the remaining required guidance equipment, such as reels, monofilament, and string. Reels were used for mobile balloons and had to be strong, in sufficient number, and with a large capacity such as those used for deep-sea fishing. This last feature enabled the field workers to reel in the balloons rapidly. The mobile and fixed balloons were held by the monofilament, therefore it had to be strong, 9.1 kg and over. When used to tie the balloons, monofilament broke the rubber. Therefore, string was needed to tie the balloons. The set-up of these three components is illustrated in Figure 4.

The ground guidance system that we used was based on the center of the flight line indicated by mobile balloons.

Each mobile balloon indicated the same flight line. To assure this, a sufficient number of workers was required. The staff for a MBL was generally composed of a supervisor and two workers. The supervisor was responsible for the workers, collected all the meteorological data before, during, and after spraying (Appendix 1), transmitted this information to the head of the operation, and assisted the workers as required. The supervisor always accompanied the workers with a stocked vehicle to provide backup in case of breakage or an emergency. The vehicule was equipped with a radio to assure communications between the aircraft and the field workers, between the airfield and the spray block, and between the various teams.

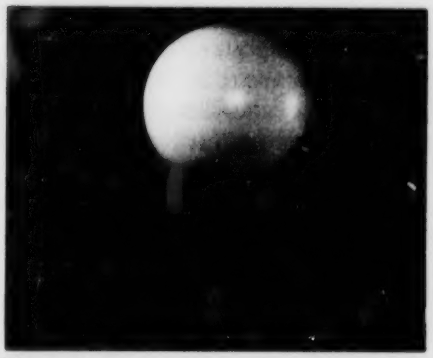


Figure 4.
Fixing a helium balloon on its string.

In Figure 5, a MBL is located at the end of a block. When the aircraft moved from FLs 31 to 32 and from FLs 33 to 34, the time allowed for moving from one FL to another was too short for one worker alone, therefore a second worker was needed. The second worker was even more necessary when two or more aircraft were involved, or when the MBL was narrow. Even if there were two workers there was only one

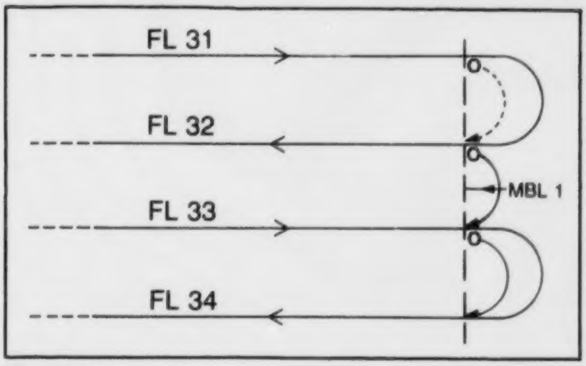


Figure 5.
Crew displacement on a mobile balloon line located at the end of a block.

balloon in the air at a time. Another advantage of having two field workers was that the second could act as a backup in case of balloon breakage. The second worker can raise another balloon, thus allowing the operation to continue.

To facilitate the pilots' task, the following two points were considered. First, to prevent the pilots from mistaking the FB for a MBL and vice versa, two balloons were tied on the same string at the FB sites and one per string at the MBL. Second, with two or more aircraft it is important that the pilot be informed of the wind direction. This prevented the pilots of tailing aircraft from being blinded by the leader's spray mist (Figure 6). Also, spraying was started at the end of the block opposite to the origin of the wind. For example, with an eastern wind, spraying was started at the west end of the block.

1.2 Aerial Guidance

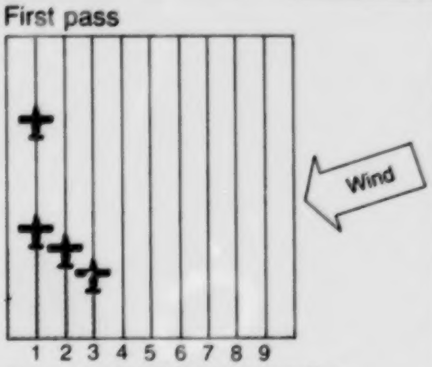
Aerial guidance was used over areas that were not easily accessible (those with no or very few roads) or over hilly terrain. Instead of helium balloon pointers, spotter aircraft (fixed wing or helicopter) were used to guide the spray pilots.

1.2.1 Preparation

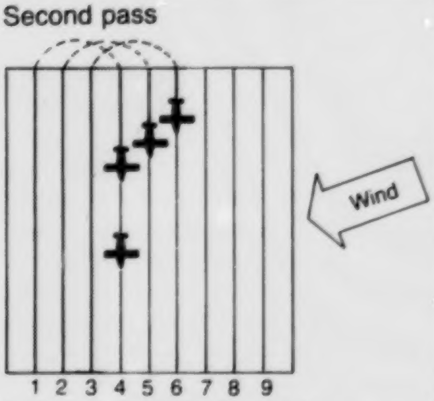
The pretreatment preparation described for the ground guidance system also applied to this technique. However, due to the absence or a reduced number of mobile balloons, the method needed less planning and staff for the operation. First, the type of aircraft to be used as a pointer was determined. The choice depended on the number of aircraft in the formation, aircraft speed, and block characteristics.

When spraying a large block (FLs longer than 5 km) and with several aircraft (or a single one with a swath width of 60 m), the spotter could be a fixed-wing aircraft or a fast helicopter. However, if the spray blocks are small or a mixture of both, a helicopter would be the better choice. We felt that a fixed-wing aircraft was not a good choice as a pointer when there was only one spray aircraft with a swath width lower than 60 m because the risk of overlap was very high.

Spraying in formation



- The pointer starts the block depending on the wind direction.
- The leading spray aircraft flies the same flight path as the pointer.
- The wingmen pass to the right.



- The leading spray aircraft flies the same flight path as the pointer.
- The wingmen pass to the left.

Figure 6.
Pattern of flight formation (Kindly supplied by Mr. Michel Pelletier, Quebec Department of Energy and Resources).

After choosing the spotter aircraft, the required personnel were recruited. We requested that pilots and ground personnel be experienced in this field. Public tenders for an aircraft contractor were then announced.

The ground preparation consisted in identifying, on aerial photographs and in the field, the area where the FB was to be located. When a MBL was easy to establish, it was used for greater precision. Helium and balloons were ordered in sufficient quantity. For this method, more small helium tanks (type D) were required because the blocks chosen for aerial navigation were more difficult to reach.

Planning from this point on was the same as that done for the ground guidance system (See section 1.1).

1.2.2 Execution

The guidance system varies according to the type of pointer used. Regardless of the method, there should always be two people in the pointer; a pilot and a navigator. The navigator's main responsibilities are to assure that spray aircraft follow the planned flight lines, to indicate when to open and close the booms, and to maintain radio communications with the ground and other aircraft.

As previously described, whether using a fixed-wing aircraft or a rapid helicopter (one which flys faster than spray aircraft) as a pointer, the technique is generally to precede the spray aircraft in order to guide them along the flight lines (Figure 6). This method requires precise coordination between the pointer and the spray aircraft. This coordination is at its peak when the pointer must simultaneously align the next FL while turning. This is the point where the risk of swath overlap or no spray reaching the target is the greatest.

When a helicopter that flys slower than the spray aircraft is used as a pointer, the guidance method is different. When spray aircraft are ready to start on a FL, the helicopter waits at a distance of about one-quarter of the total flight length at an altitude of 100 to 125 m, facing the spray aircraft and indicating FL direction with its tail or with a strong beam light (Figure 7). Once the spray aircraft have passed under the helicopter, it follows, constantly correcting (if necessary) the direction of the head aircraft through the aid of the ground guidance system (Figure 7). When the last quarter of the FL is reached the helicopter stops moving, guides the spray aircraft, and indicates precisely when the spraying is to end. While the spray aircraft are turning, the helicopter moves to the next FL and once again aligns with ground indicators.

Many types of helicopters may be used as pointers. In our operations, we used the Hughes 500-C. This model provides a very good view of the ground and its jet engine allows it to reach 200 km/h. Since this model flies faster than the 450 and 600 HP Grumman AgCat aircraft, we used the first guidance technique mentioned above. A good alternative is the Hughes 300-C helicopter. It costs less to rent than the Hughes 500-C and, as with all Hughes helicopters, it offers a good view of the ground. However, its piston engine limits its speed to 140 km/h.

This knowledge of the different pointers available helped us to make a choice once all the other

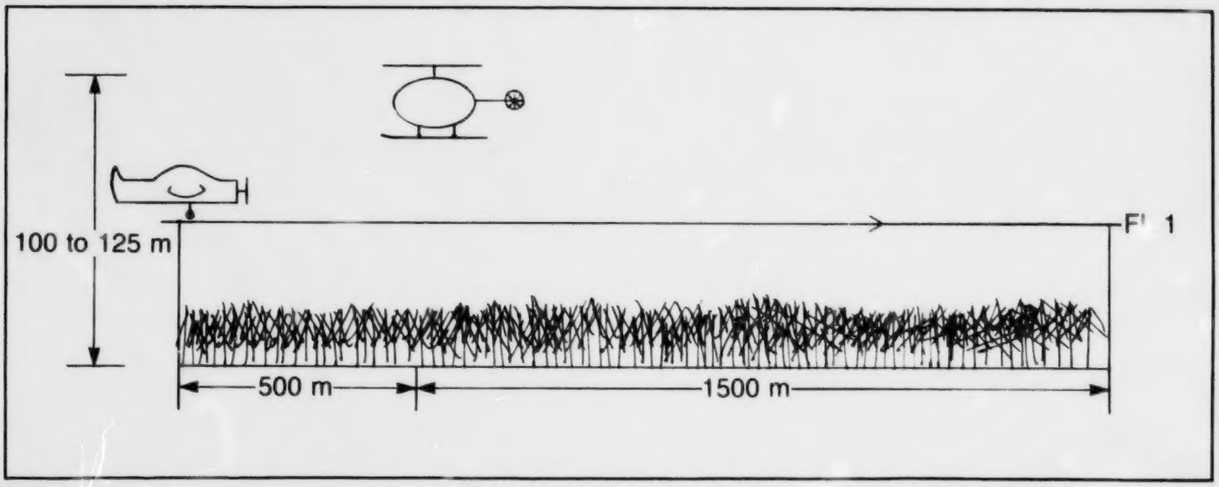


Figure 7.
Aerial guidance system with a low-flying helicopter.

pertinent information regarding the spray program was known. This information included: total area to be treated, block characteristics, site topography, the type of spray aircraft to be used, and the available funding.

When a road was inside a spray block, a MBL was used to improve guidance precision. However, this increased the cost of the guidance system and was used only for hilly parts of the blocks or when availability of access roads made the use of a MBL easy.

MATERIAL REQUIRED FOR THIS PHASE OF THE PROTECTION PROGRAM

Uses	Material specifications	Suppliers
Ground navigation	Balloons	Les ballons Granger, Montreal
Ground or aerial navigation	Topographic map 1:50 000	Regional office, Energy, Mines and Resources Canada
Ground or aerial navigation	Aerial photographs	Department of Energy and Resources, Quebec
Ground or aerial navigation	Helium and flow regulator	Local supplier of welding material
Navigation — pathway cleaning	Axes, saws, flagging tape, fluorescent paint, machetes	Local hardware stores, game and fishing stores, forestry material suppliers
Ground or aerial navigation	Flashlights	Local hardware stores
Helium tank holder	Wood, nails, brackets	Local hardware stores
Ground or aerial navigation	Radio (walkie-talkie)	Rental from a local supplier (ex. Quebec Telephone)
Ground or aerial navigation	Reels, monofilament, string	Local hardware stores, game and fishing stores
Meteorological equipment	Windmeter, revolving psychometer	Dendrotik Inc. #89001, Fisher Scientific 11-664-10.
Aerial navigation	Fixed-wing aircraft or helicopter	Licensed rental service

SCHEDULE OF ACTIVITIES

1. Guidance systems:
   April to June

TECHNICAL LEAFLET 4

APPLICATION

1. THE INSECTICIDE
    1.1 Purchasing the insecticide
    1.2 Assessing insecticide potential and purity
    1.3 Insecticide delivery
    1.4 Mixing facilities and assessing the quality of the mixture

2. PREPARATION FOR SPRAYING
    2.1 Choosing the aircraft
    2.2 Calibration of aircraft and spray systems
    2.3 Choosing airfields
    2.4 Ground to ground and air to ground radio communications

3. SPRAYING THE INSECTICIDE AND ASSESSING EFFICIENCY
    3.1 Planification of spray operations
    3.2 Spraying periods
    3.3 Methods of control

REFERENCES

MATERIAL REQUIRED FOR THIS PHASE OF THE PROTECTION PROGRAM

SCHEDULE OF ACTIVITIES

1. THE INSECTICIDE

1.1 Purchasing the insecticide

In Canada, when planning to use *B.t.* in forestry, you have the choice of three commercial preparations:

DIPEL: manufactured and sold by Abbott Laboratories, North Chicago, Illinois, USA;

FUTURA: made from a primary powder produced by Duphar Holland, and sold in Canada by Chemagro Limited, Mississauga, Ontario;

THURICIDE: sold in Canada by Sandoz Agro Canada Inc, Mississauga, Ontario.

These are the only products registered for use against spruce budworm in Canada (this information should be updated regularly with the Pesticide Directorate, Agriculture Canada). In our program, Futura FC and Futura XLV were used at a concentration of 20×10^9 international units/ha in a final volume of 2.5 L/ha.

Before preparing the specifications for purchasing the insecticide, the concentration to use against the target insect, the volume/ha to be dispersed, and the mode of dispersion (ground or aerial) was determined. This information is available in several scientific or technical documents. However, the manufacturers' labels (Figures 1 and 2) should be consulted first. These labels contain useful information and their recommendations are supervised by Agriculture Canada under the Pest Control Products Act. They can be obtained either from the Pesticide Directorate, Agriculture Canada, or from the manufacturer.

The registration number and the dosage and volume recommended for a given insect are included on the label. For the spruce budworm, the manufacturers usually indicate a range of dosages and volumes on the label. Therefore, the user must make a choice based on the type of aircraft and spray system to be used, area to be treated, funding available, spruce budworm population levels, and tree condition. In Canada, at the time of writing, the most frequently used preparations are (in alphabetical order): Dipel 132, in a dosage of 30 BIU/ha, undiluted, in a volume of 1.57 to 2.34 L/ha; Futura XLV in a dosage of 20 to 30 BIU/ha, undiluted or diluted in water, in a volume of 1.35 to 2.5 L/ha; and Thuricide 48LV, in a dosage of 20 to 30 BIU/ha, undiluted, in a volume of 1.57 to 2.34 L/ha. The purchase specifications should reflect both the quality, based on the predetermined requirements, and the quantity, based on the area to be treated with regards to the dosage and volume per hectare to be used. An example of purchase order specifications is given in Appendix 1. In our program, the recommendation of Smirnoff and Valéro (1983) served as a base.

1.2 Assessing insecticide potential and purity

Both the potential and purity of the product were checked. The potential of the product is determined by bioassays on a standard insect, the cabbage looper (*Trichoplusia ni*). This procedure determines the time lapse required to obtain a given larval mortality and was adopted by an international commission of standards in 1966. In our program, the potential was verified by an independent laboratory.

Another method is based on the number of spores in the preparation. Through mathematical conversion, this number is then transferred into international units. This method, developed by Smirnoff (1982), is based on the principle that there is an even number of spores and crystals in *B.t.* preparations. However, this method has not been accepted by manufacturers. The required potential of the product was stated in the specifications (Appendix 1) and was determined by bioassays.

The Smirnoff method evaluates the purity of the product by the presence or absence of foreign microorganisms on the culture medium. Also, if *B.t.* does not grow on the medium, phages (virus of bacteria) may be present. The purity of *B.t.* is also verified by injecting it into white mice.

The growth of *B.t.* on a specific culture medium is the best way to verify the purity of the preparation. Purity requirements were also included in the specifications (Appendix 1) and the analyses carried out by Agriculture Canada or an indepen-

FUTURA®

Suspension
Suspension concentrée

BIOLOGICAL INSECTICIDE
FOR FOREST AND WOODLAND USE

INSECTICIDE BIOLOGIQUE
POUR LA FORÊT ET LES TERRAINS BOISÉS

RESTRICTED
USAGE RESTREINT

READ THE LABEL BEFORE USING
LIRE ATTENTIVEMENT L'ÉTIQUETTE AVANT L'EMPLOI

KEEP OUT OF REACH OF CHILDREN
GARDER HORS DE LA PORTEE DES ENFANTS

Net Contents: 200 Litres / Contenu net: 200 Litres

Specific Gravity: 1.2 / Gravité spécifique 1,2

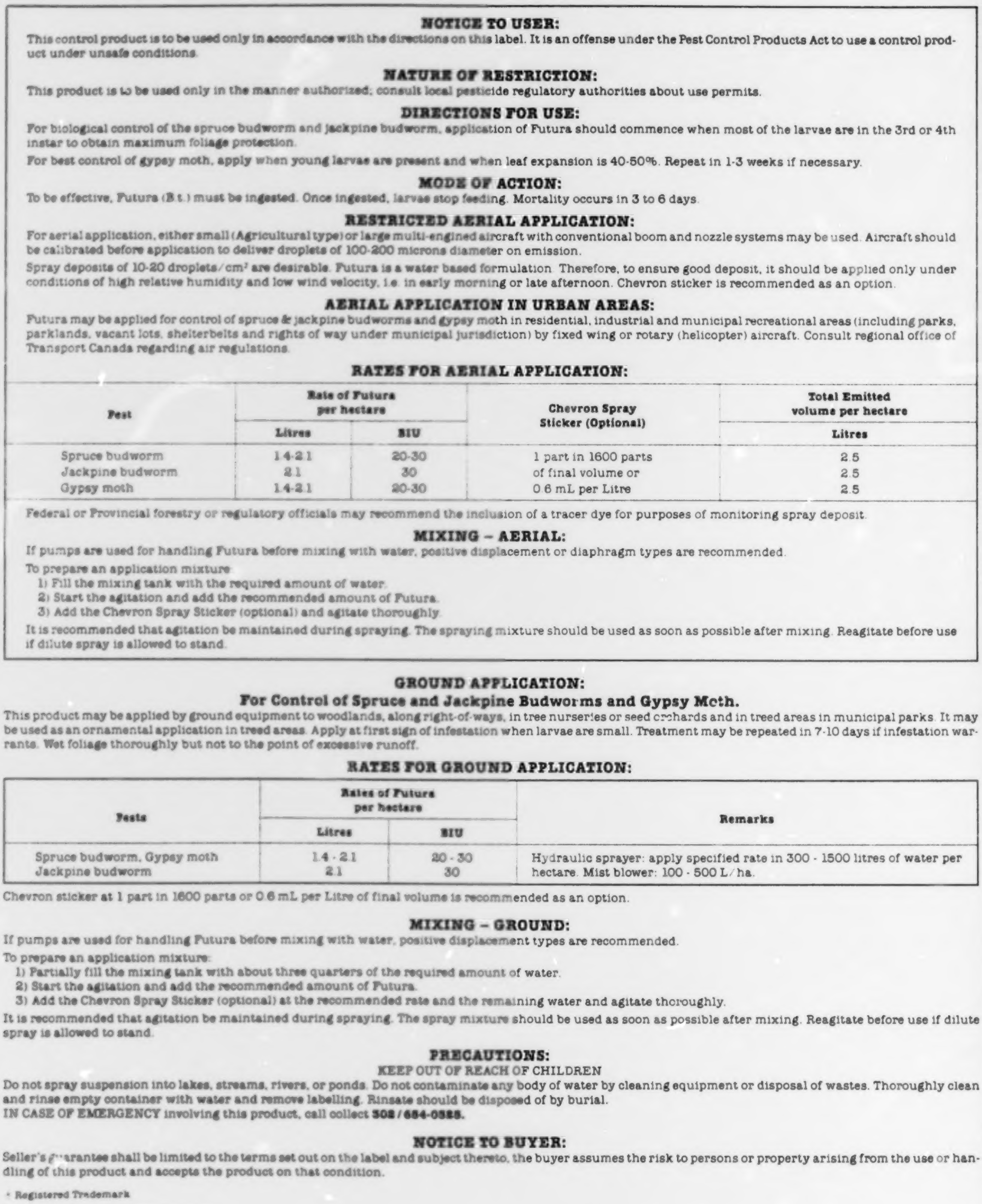
GUARANTEE: *Bacillus thuringiensis* Berliner, var. *kurstaki*, . . . potency of 12,000 International Units per milligram of formulated product (equivalent to 14.4 Billion International Units of potency per Litre)

GARANTIE: *Bacillus thuringiensis* Berliner, variété *kurstaki*, . . . 12,000 Unités Internationales d'activité par milligramme de produit formulé (équivalent a 14.4 Milliards d'Unités Internationales d'activité par litre de produit)

REGISTRATION NO. 17778 PEST CONTROL PRODUCTS ACT
N° D'ENREGISTREMENT: 17778 LOI SUR LES PRODUITS ANTIPARASITAIRES

Biochem Products
A Division of Salsbury Laboratories, Inc., Montchanin, Delaware 19710

Canadian Agent: / Agent Canadien:
Chemagro Limited, 256 Britannia Road East, Mississauga, Ontario L4Z 1S6



NOTICE TO USER:

This control product is to be used only in accordance with the directions on this label. It is an offense under the Pest Control Products Act to use a control product under unsafe conditions.

NATURE OF RESTRICTION:

This product is to be used only in the manner authorized; consult local pesticide regulatory authorities about use permits.

DIRECTIONS FOR USE:

For biological control of the spruce budworm and jackpine budworm, application of Futura should commence when most of the larvae are in the 3rd or 4th instar to obtain maximum foliage protection.

For best control of gypsy moth, apply when young larvae are present and when leaf expansion is 40-50%. Repeat in 1-3 weeks if necessary.

MODE OF ACTION:

To be effective, Futura (B.t.) must be ingested. Once ingested, larvae stop feeding. Mortality occurs in 3 to 6 days.

RESTRICTED AERIAL APPLICATION:

For aerial application, either small (Agricultural type) or large multi-engined aircraft with conventional boom and nozzle systems may be used. Aircraft should be calibrated before application to deliver droplets of 100-200 microns diameter on emission.

Spray deposits of 10-20 droplets/cm^2 are desirable. Futura is a water based formulation. Therefore, to ensure good deposit, it should be applied only under conditions of high relative humidity and low wind velocity, i.e. in early morning or late afternoon. Chevron sticker is recommended as an option.

AERIAL APPLICATION IN URBAN AREAS:

Futura may be applied for control of spruce & jackpine budworms and gypsy moth in residential, industrial and municipal recreational areas (including parks, parklands, vacant lots, shelterbelts and rights of way under municipal jurisdiction) by fixed wing or rotary (helicopter) aircraft. Consult regional office of Transport Canada regarding air regulations.

RATES FOR AERIAL APPLICATION:

Pest	Rate of Futura per hectare		Chevron Spray Sticker (Optional)	Total Emitted volume per hectare
	Litres	BIU		Litres
Spruce budworm	1.4-2.1	20-30	1 part in 1600 parts	2.5
Jackpine budworm	2.1	30	of final volume or	2.5
Gypsy moth	1.4-2.1	20-30	0.6 mL per Litre	2.5

Federal or Provincial forestry or regulatory officials may recommend the inclusion of a tracer dye for purposes of monitoring spray deposit.

MIXING – AERIAL:

If pumps are used for handling Futura before mixing with water, positive displacement or diaphragm types are recommended.

To prepare an application mixture:

1) Fill the mixing tank with the required amount of water.
2) Start the agitation and add the recommended amount of Futura.
3) Add the Chevron Spray Sticker (optional) and agitate thoroughly.

It is recommended that agitation be maintained during spraying. The spraying mixture should be used as soon as possible after mixing. Reagitate before use if dilute spray is allowed to stand.

GROUND APPLICATION:

For Control of Spruce and Jackpine Budworms and Gypsy Moth.

This product may be applied by ground equipment to woodlands, along right-of-ways, in tree nurseries or seed orchards and in treed areas in municipal parks. It may be used as an ornamental application in treed areas. Apply at first sign of infestation when larvae are small. Treatment may be repeated in 7-10 days if infestation warrants. Wet foliage thoroughly but not to the point of excessive runoff.

RATES FOR GROUND APPLICATION:

Pests	Rates of Futura per hectare		Remarks
	Litres	BIU	
Spruce budworm, Gypsy moth Jackpine budworm	1.4 - 2.1 2.1	20 - 30 30	Hydraulic sprayer: apply specified rate in 300 - 1500 litres of water per hectare. Mist blower: 100 - 500 L/ha.

Chevron sticker at 1 part in 1600 parts or 0.6 mL per Litre of final volume is recommended as an option.

MIXING – GROUND:

If pumps are used for handling Futura before mixing with water, positive displacement types are recommended.

To prepare an application mixture:

1) Partially fill the mixing tank with about three quarters of the required amount of water.
2) Start the agitation and add the recommended amount of Futura.
3) Add the Chevron Spray Sticker (optional) at the recommended rate and the remaining water and agitate thoroughly.

It is recommended that agitation be maintained during spraying. The spray mixture should be used as soon as possible after mixing. Reagitate before use if dilute spray is allowed to stand.

PRECAUTIONS:

KEEP OUT OF REACH OF CHILDREN

Do not spray suspension into lakes, streams, rivers, or ponds. Do not contaminate any body of water by cleaning equipment or disposal of wastes. Thoroughly clean and rinse empty container with water and remove labelling. Rinsate should be disposed of by burial.
IN CASE OF EMERGENCY involving this product, call collect **302 / 654-0325.**

NOTICE TO BUYER:

Seller's guarantee shall be limited to the terms set out on the label and subject thereto, the buyer assumes the risk to persons or property arising from the use or handling of this product and accepts the product on that condition.

* Registered Trademark

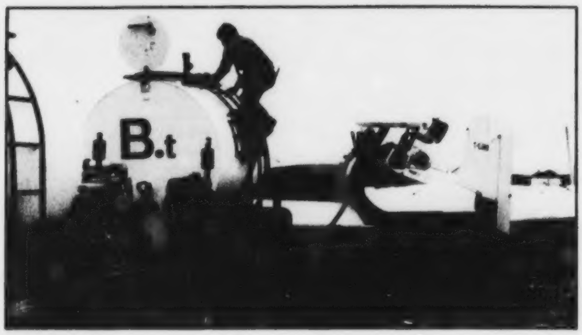
Figures 1 and 2.
Futura label.

dent laboratory. For our operations, we required that the manufacturer indicate the lot number on the top of the drums to facilitate identification during sampling.

1.3 Insecticide delivery

With small-scale operations involving single-engine aircraft or helicopters, we found it useful to order the material in 200-L (45 imp. gal.) drums. For large operations with four-engine aircraft, the *B.t.* preparation can be delivered in bulk containers.

1.4 Mixing facilities and assessing the quality of the mixture



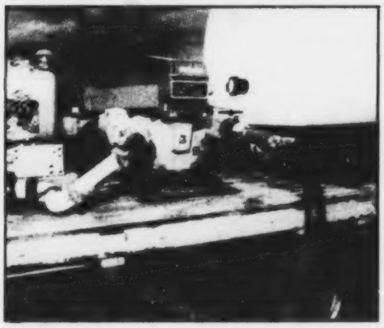


Figure 3.
Sections of mixing facilities.

For operational use, concentrated *B.t.* was diluted in water. A water tank and a mixing tank (Appendix 2 and Figure 3) made up our mixing facilities. Rigid pipes, 5 to 10 cm in diameter, were connected to the tanks. Liquid counters were used to estimate the quantity of water and *B.t.* concentrate going into the mixing tank and to measure the quantity of formula loaded into the aircraft. However, considering the limited area of private woodlots, our mixing facilities were made up of two 3400-L tanks. *B.t.* was kept in the drums until preparation. Then, it was pumped from the drums directly into the mixing tank. The formula to be prepared was based on the number of 200-L drums of *B.t.* required for a mix. Water was added proportionally. The table used for mixing is given in Appendix 3.

As our spray program required moving from base to base, two or three trailer-mounted mixing facilities were used. One was installed on a 3-axle mobile home trailer chassis (Figure 4). It was moved by a tractor truck similar to those used to move mobile homes.

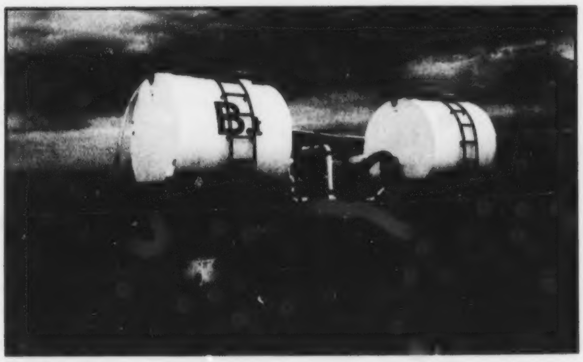


Figure 4.
Mixing facility on a mobile home chassis.

Another mixing facility was installed on a trailer which was handled by a 3-axle base truck (Figure 5). And a third mixing unit was fixed on a trailer (Figure 6.) Details of the mixing facilities used is given in Appendix 4. Two of the three mixing facilities were kindly supplied by the Quebec Department of Energy and Resources until 1987. The third mixing plant was constructed on site by the Lower St. Lawrence Wood Producers' Association using local supplies and resources. In 1988, both wood producers' associations used mixing facilities of their own. At the end of this section, a list of material used to build our mixing facilities is given to help those who are interested in setting up a mixing unit.

Figure 5.
Mixing facility on a trailer handled by a three-axle truck.

Figure 6.
Mixing facility on a trailer.

2. PREPARATION FOR SPRAYING

2.1 Choosing the aircraft

Single-engine aircraft were used to spray small woodlots. Although they are more expensive, helicopters can be, in some circumstances, more efficient. Presently, the following types of spray aircraft are used: Turbo Trush, Trush Commander, Bull Trush, AgCat, and Pawnee.

The choice of aircraft depends on their availability and the cost-profit ratio based on the average size of each block and the total area to be treated.

Our rental specifications mentioned the number and type of aircraft required and the method of payment. An example of rental specifications is given in Appendix 5 and Appendix 6 presents an example of an aircraft rental contract.

2.2 Calibration of aircraft and spray systems

To carry out our program in private woodlots in eastern Quebec, the Grumman AgCat aircraft equipped with booms and Teejet™ flat-fan #8004 nozzles were used. The aircraft spray system combination was based on results of extensive research. Forestry Canada can be contacted for further spray technology information.

2.3 Choosing airfields

Operational bases (airfields) were established in light of the type of aircraft used. To illustrate how an airfield is chosen, the process used in our program is outlined.

The chosen aircraft, Grumman AgCat 450 HP, with a full load, [760 L (200 U.S. gallons) of insecticide in our operation] has a two-hour (120 minutes) flight autonomy. For a 600-HP Grumman AgCat the full load is 946 L (250 U.S. gal.). Calibration of the aircraft (450 HP) established the flow rate required to deliver 2.5 L/ha at 22.3 L/min. Without calculating the time required for ferrying from the airfield and for turning at the end of each flight line, 34 minutes were required to spray the load. Flight lines were generally 4 km long, therefore turning time was estimated to be 75% of spray time (34 × 0.75) or 25 minutes, which left 61 minutes for the ferry fight [120 + (34 — 25) = 61].

If an aircraft (full load) is to be used economically, operational bases should be within 30 minutes from the spray blocks. Longer ferry flights would mean operating aircraft with proportionally less insecticide, thus reducing the cost effectiveness of the operation.

For safe operations, the Grumman AgCat needs a 600-m (2000 ft) long by 30-m (100 ft) wide runway. The airstrip surface can be either gravel, grass, or pavement.

Another important point to consider when determining the site of our bases was the water supply. The quantity of water required for mixing *B.t.* is easily established from the quantity of final formula to be sprayed from each base. To assure a sufficient water supply for cleaning the aircraft and the mixing facilities, this amount was multiplied by 1.6. Also, the water supply sources (municipal water supply, creeks, lakes, wells) were localized as soon as the bases were chosen, since water samples had to be analyzed for quality. For spraying, a water with a maximum of 200 fecal coliforms/100 mL (swimming water requirements in Quebec) was found acceptable.

2.4 Ground to ground and air to ground radio communications

Good radio communications are essential in assuring the success of a protection program. Therefore, when our communications were planned the area of the target territory and environmental requirements were taken into consideration. Communications were divided into two units: ground to ground and air to ground.

When the executing organizations, such as the wood producers' associations, do not have a radio communication system, the first step is to contact the local public communications supplier.

Our ground communication system consisted of: one or more transmitter-receiver bases, mobile transmitter-receivers in the vehicles of each project leader and technician (team leader), and also portable transmitter-receivers for each field worker. All ground communications were on FM frequency. Bases and mobile units were multi-channel devices with simplex frequency. Portable transmitter-receivers worked on the simplex frequency only. The simplex frequency was indispensable for reaching field staff and operated even in areas where antennas were out of range.

Communications schema

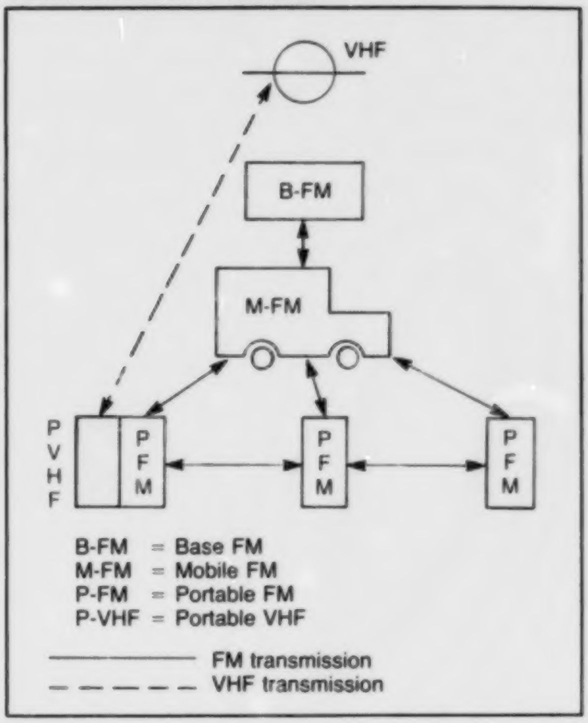


Figure 7.
Communications schema.

Air to ground communications were established to help the spray operation and to meet environmental requirements. They were based on the use of portable transmitter-receivers (on the ground) on frequencies corresponding to those of the aircraft radios. They worked on very high frequency (VHF). These portable transmitter-receivers were supplied by the spray contractor as part of its contractual obligation. The contractor was required to have radios inserted in the pilots' helmets for better receiving. The communication pattern is given in Figure 7.

3. SPRAYING THE INSECTICIDE AND ASSESSING EFFICIENCY

3.1 Planning the spray operation

Three steps were used in flight planning. The first was theoretical and advanced planning based on the relation of the locations of airfields to the spray blocks. Spray simulations were developed for different schedules of block openings depending on insect development in order to determine the number of flights required and the time needed for each one. An example of spray simulation is given in Appendix 7.

In the second step, flights were planned with ground or aerial navigators or both if necessary. Ground workers were given survey maps (1:50 000) indicating flight line (FL) location and direction, flight line numbers, location of fixed balloons (FB) with their respective identification numbers, and location of mobile balloon lines (MBL) with their respective identification numbers (Figure 8). Subsequently, prior to each spray period, field teams and pilots were briefed. A map (Figure 8) was prepared for every spray flight (or flight formation). Therefore, each worker had more than one map covering an entire spray block. Spraying was based on a maximum of three flights in the morning and two in the evening. This maximum was only reached when meteorological conditions were ideal.

During the third step, flight planning was developed with the pilots. During a preliminary session, the general aspect of the program was examined with the pilots and they were given maps of the blocks. These maps included block and base locations, details of all environmental constraints, and indicated the flight routes between blocks and bases, the areas eliminated from the spray programs, and areas for emergency unloading (Figure 9). Flight planning was completed through briefings held prior to every flight and follow-up discussions with pilots at the end of each spray period. Field and base workers and pilots were in constant communication to make any urgent correction required to the original pattern.

3.2 Spraying periods

The spraying periods depend on the following meteorological conditions:

— temperature under 20°C;

— relative humidity higher than 70%;

— unidirectional winds lower than 10 km/h; and

— no rain expected for the next 3 hours.

Frequently, these conditions are encountered at sunrise and sunset. More stable meteorological conditions occur in the morning because the ground cools during the night, often allowing two or three flights per morning. At dusk, particularly after a warm sunny day, the ground takes longer to cool and the air is unstable, which allows only one spraying period. The length of spraying periods may be increased by overcast skies, which prevent thermal turbulence. Mechanical turbulence, resulting from the breaking of the wind on natural obstacles, does not affect spray quality.

3.3 Methods of control

The control mentioned in this leaflet refers to mixture control and deposit assessment. For mixture control the worker in charge of the mixing facilities filled out various forms. In addition to being a fundamental ForCan requirement, this control is also required by the Quebec Department of the Environment. The first form to be completed is "Quantity of mixture prepared", which is designed to check the accuracy of the formula (Figure 10). The second form, "Flight Report", lists the number of spray lines completed, the quantity of product dispersed, flying time, and the sprayed block or block section (Figure 11). The information given in this report, especially on the flight lines treated/product dispersed ratio, provided a continuous verification of flowrate, i.e. volume/ha dispersed. This report was signed by both the pilot and the manager.

The second control was deposit assessment. To make the operation easier, the simplest method was used. Petri dishes containing nutrient agar medium were used to assess *B.t.* colonies. This method was facilitated by numerous roads in private woodlots. The first step consisted in identifying, on maps (1:50 000) or aerial photographs, roads and open woodlot boundaries perpendicular to flight lines (Figure 12) in the spray blocks. Prior to spraying, open Petri dishes with nutrient agar medium were placed at every 30 m in the chosen openings (Figure 13). Thirty minutes after spraying was completed, the dishes were covered and brought back to the office or laboratory to be

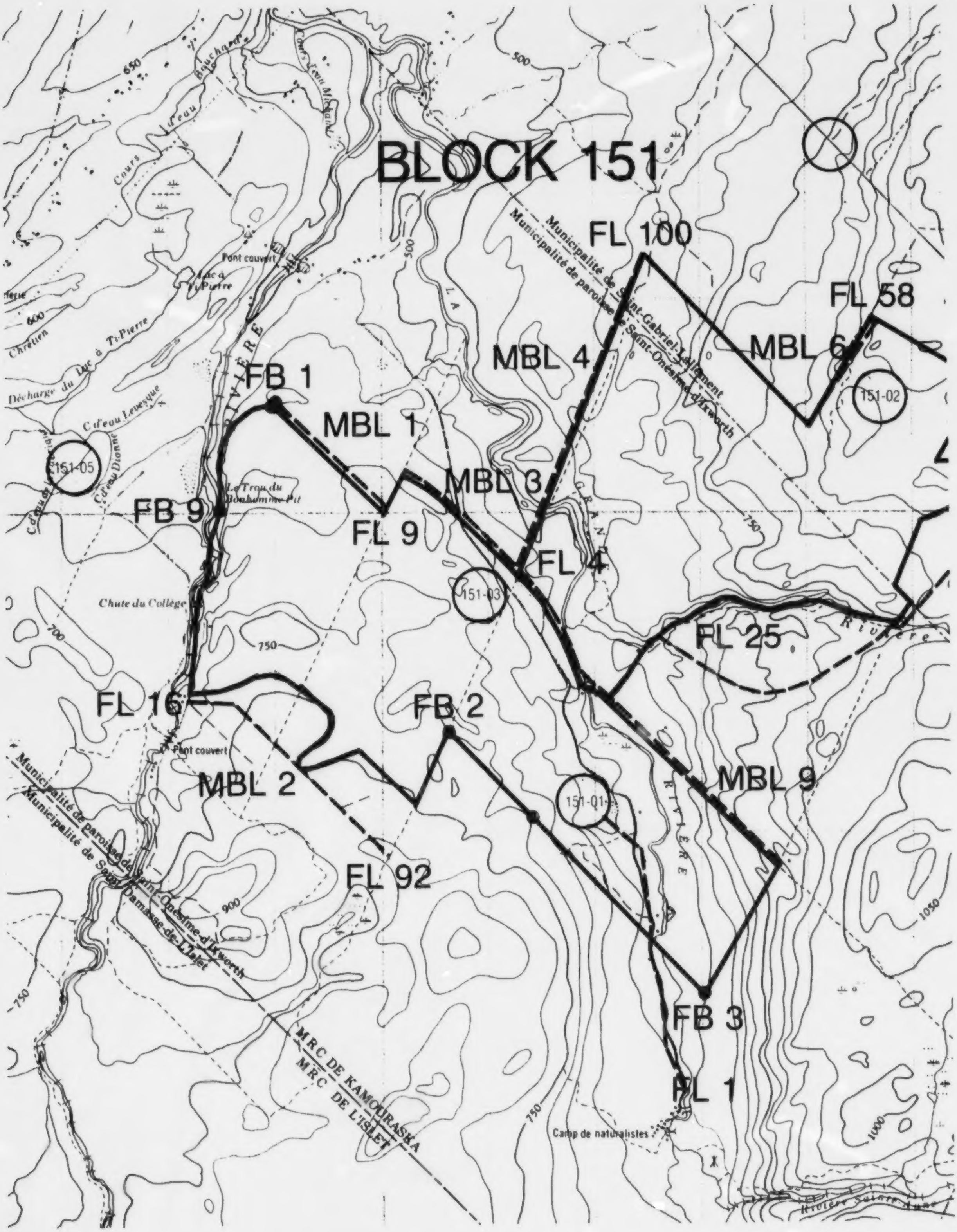

BLOCK 151
FL 100
FL 58
MBL 6
MBL 4
FB 1
MBL 1
MBL 3
FB 9
FL 9
FL 4
FL 25
FL 16
FB 2
MBL 2
MBL 9
FL 92
FB 3
FL 1
151-01
151-02
151-03
151-05
Municipalité de Saint-Gabriel-Lalemant
Municipalité de paroisse de Saint-Onésime-d'Ixworth
Municipalité de paroisse de Saint-Onésime-d'Ixworth
Municipalité de Saint-Damase-de-L'Islet
MRC DE KAMOURASKA
MRC DE L'ISLET
Pont couvert
Pont couvert
Chute du Collège
Le Trou du Bonhomme Pit
Décharge du Lac à Ti-Pierre
Lac à Ti-Pierre
C d'eau Levesque
C d'eau Dionne
Cours d'eau Bouchard
Cours d'eau Michaud
Camp de naturalistes
Rivière Sainte-Anne
500
600
650
700
750
900
1000
1050

Figure 8.
Example of maps given to navigators.

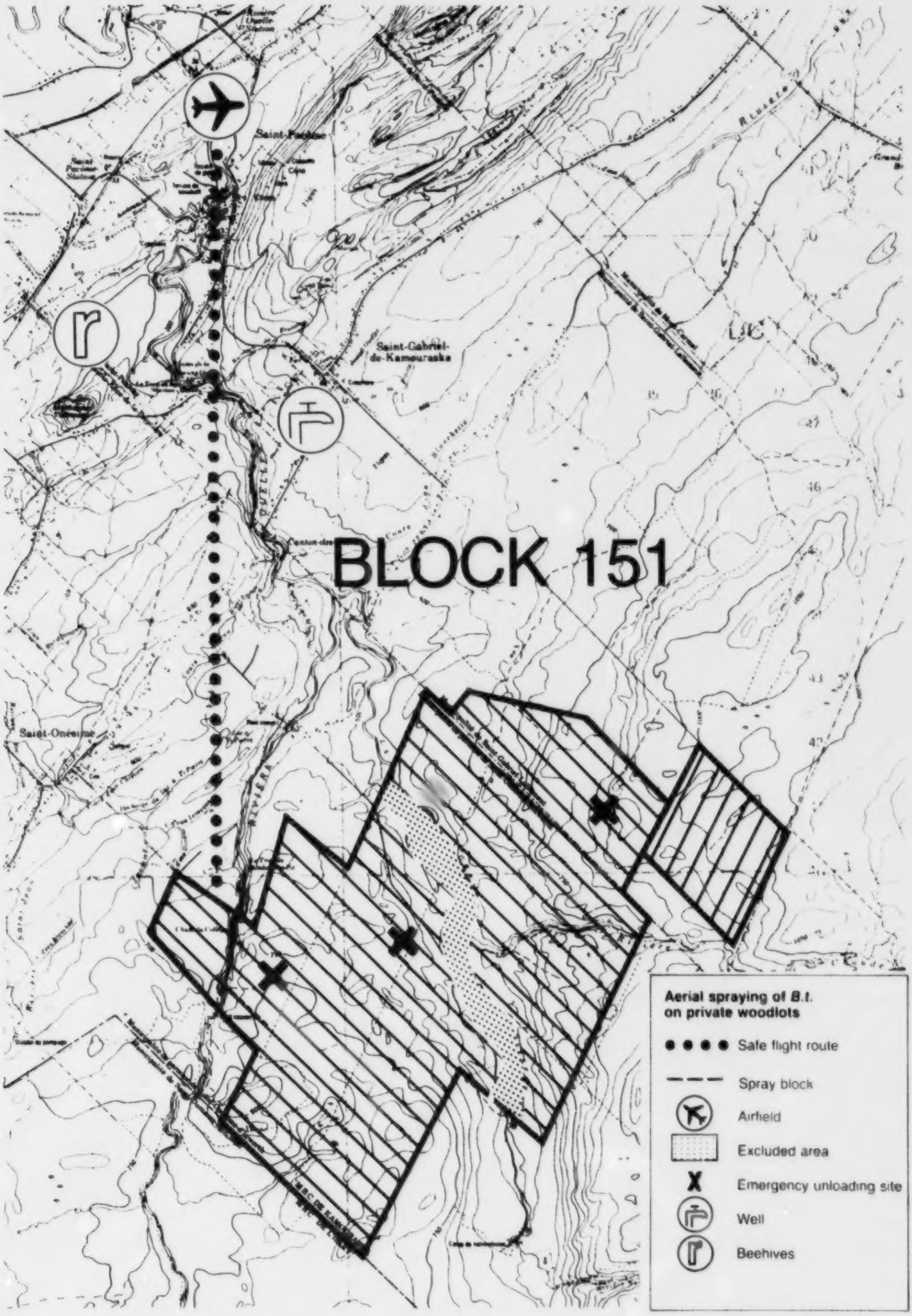

Saint-Pacôme
Saint-Gabriel-de-Kamouraska
BLOCK 151
Saint-Onésime
Aerial spraying of *B.t.* on private woodlots
● ● ● ● Safe flight route
– – – Spray block
Airfield
Excluded area
Emergency unloading site
Well
Beehives

Figure 9.
Example of maps given to pilots.

Quantity of mixture prepared

Mix no: ______________________________

Date: ______________________________

Hour: ______________________________

Bacillus thuringiensis concentrate: ______________________________ US gal.

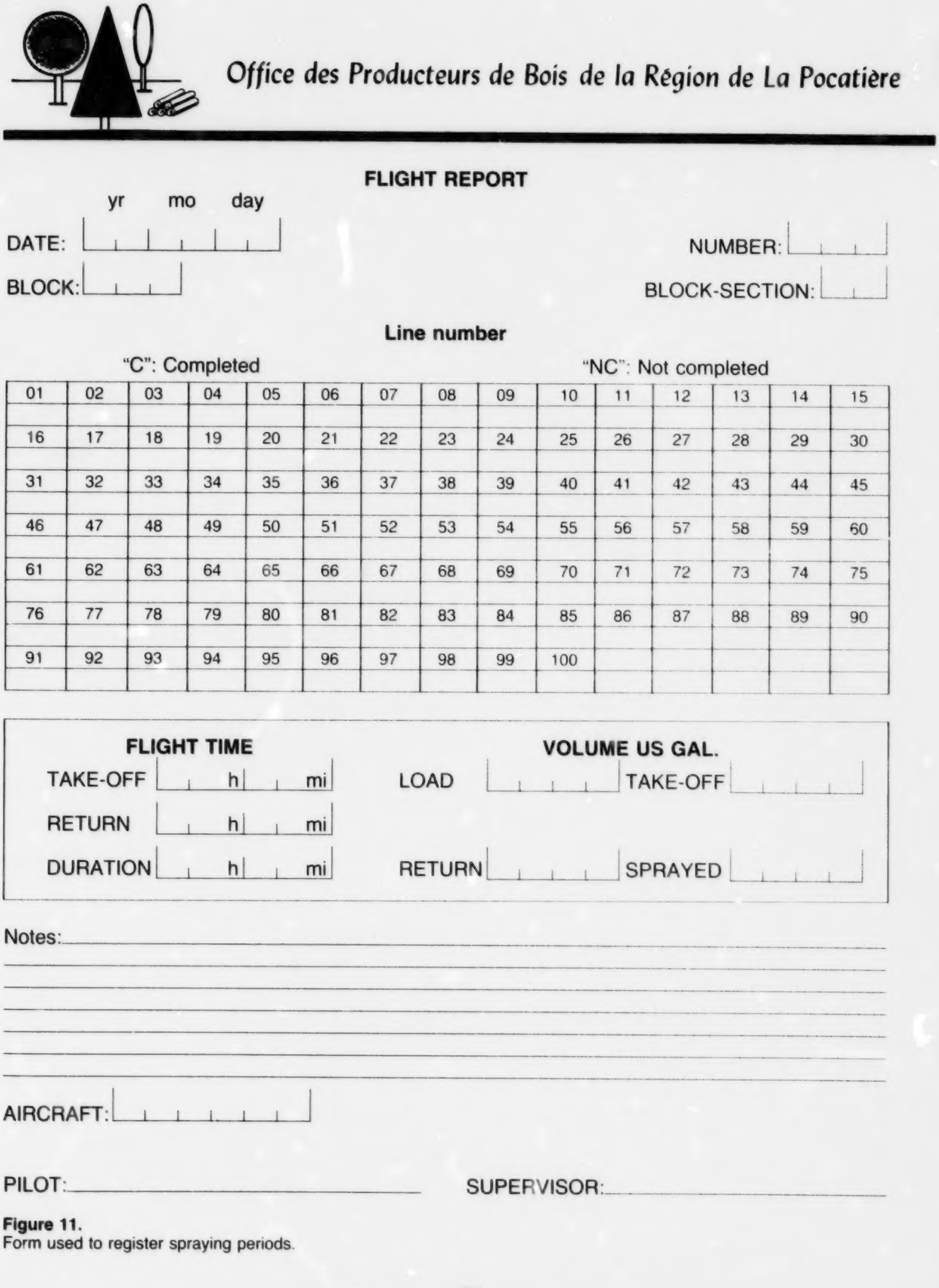
Water: ______________________________ US gal.

Sticker: ______________________________ US gal.

____

Signature

Figure 10.
Form used to register the quantity of mixture prepared.



Office des Producteurs de Bois de la Région de La Pocatière

FLIGHT REPORT

yr mo day

DATE: ☐☐☐☐☐☐

NUMBER: ☐☐☐

BLOCK: ☐☐☐

BLOCK-SECTION: ☐☐

Line number

"C": Completed

"NC": Not completed

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100					

FLIGHT TIME

TAKE-OFF ☐☐ h ☐☐ mi

RETURN ☐☐ h ☐☐ mi

DURATION ☐☐ h ☐☐ mi

VOLUME US GAL.

LOAD ☐☐☐☐ TAKE-OFF ☐☐☐☐

RETURN ☐☐☐☐ SPRAYED ☐☐☐☐

Notes:

AIRCRAFT: ☐☐☐☐☐☐

PILOT:

SUPERVISOR:

Figure 11.
Form used to register spraying periods.

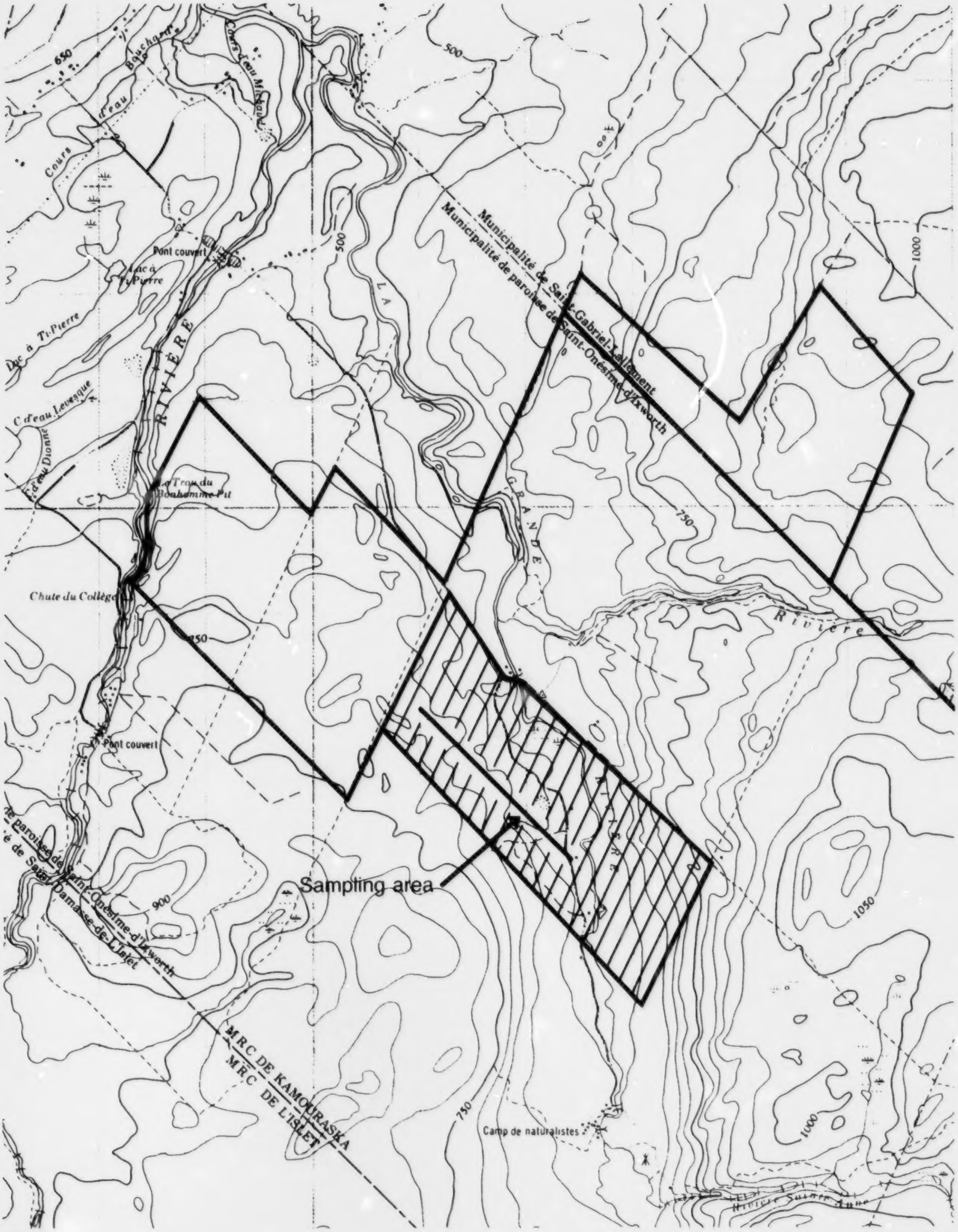

Sampling area
Municipalité de Saint-Gabriel-Lalemant
Municipalité de paroisse de Saint-Onésime-d'Ixworth
Municipalité de paroisse de Saint-Onésime-d'Ixworth
Municipalité de Saint-Damase-de-L'Islet
MRC DE KAMOURASKA
MRC DE L'ISLET
RIVIÈRE
LA GRANDE RIVIÈRE
Rivière
Pont couvert
Pont couvert
Lac à Ti-Pierre
Cours d'eau Bouchard
Cours d'eau Michaud
C. d'eau Levesque
C. d'eau Dionne
Le Trou du Bonhomme-Pit
Chute du Collège
Camp de naturalistes
Rivière Sainte-Anne
650
500
500
750
850
900
750
1000
1050
1000

Figure 12.
Map showing a deposit assessment pattern.

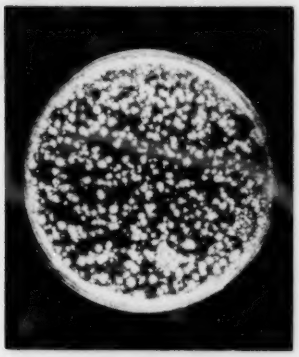


Figure 13.
Petri dishes with nutrient agar medium used for deposit assessment.

incubated in darkness at 28°C for 18 hours. Each dish was properly identified by: block number, subsection number, date and time of treatment, and location number. The location number, which corresponded to the number indicated on the maps, was important because it helped to identify forgotten or overlapped areas.

After incubation, the number of *B.t.* colonies growing on the medium were estimated with the help of a colony counter and results were expressed in number of colonies/cm^2. To make the operation easier, five 1-cm squares were identified on the counter screen and the average number of colonies in these five areas was counted (Figure 14). Results were reported on a special form (Appendix 8).

Deposit assessment was performed by a specialized team. Workers responsible for guiding aircrafts did not have sufficient time to carry out this task.

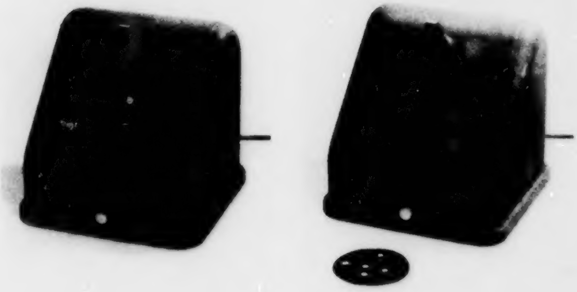


Figure 14.
Observing *B.t.* colonies on a colony counter.

REFERENCES

Smirnoff, W.A. 1982. Instructions for evaluating deposit of *Bacillus thuringiensis* formulas during aerial treatment. Environ. Can., Can. For. Serv., Laurentian For. Res. Cent., Sainte-Foy, Quebec. Inf. Rep. LAU-X-54.

Smirnoff, W.A. and Valéro, J.R. 1983. Characteristics of a highly concentrated *Bacillus thuringiensis* formulation against spruce budworm, *Choristoneura fumiferana* (Lepidoptera: Tortricidae). Can. Entomol. 115: 443-444.

MATERIAL REQUIRED FOR THIS PHASE OF THE PROTECTION PROGRAM

Uses	Material Specifications	Supplies
Bioassays	Service contract	Laboratory of microbiology
Assessing quality of commercial *B.t.* products	Service contract	Laboratory of microbiology or Agriculture Canada
Aerial spraying	Spray aircraft	Arrosages aériens du Saguenay Lac St-Jean Ltée 3980 Mathias Shipshaw, Quebec G0V 1V0
		Agric Air Inc. 185, Route 137 Sainte-Cécile de Milton Quebec J0E 2C0
Mixing facilities	Steel tanks	Audet Soudures, Quebec
	Fiberglass tanks	Megafibre, Mont-Joli
	Pumps	Pompes industrielles Sainte-Foy, Quebec
		Wajax, Quebec
	Pipes and strainers	Westburne, Quebec
	Fittings and syphons	Equipement Germain Inc. Quebec
	Counters and filters	Liquidex Ville d'Anjou, Quebec
		Rockwell International of Canada Saint-Laurent, Quebec
	Pumps and hoses (rental)	Perco Inc., Quebec Manutech Inc., Sainte-Foy Omel Inc., Vanier, Quebec
	Trailer	Carbonneau et Turgeon Inc. Saint-Romuald, Quebec

Uses	Material Specifications	Supplies
Radio communications	FM transmitter-receiver	Quebec telephone, Rimouski Télésystème National Sainte-Foy, Quebec
Flight planning	Survey maps	Regional offices, Energy, Mines and Resources, Canada
Deposit assessment	Plastic petri dishes (unique use) with nutrient agar medium	Institut Armand Frappier Montreal, Quebec
Incubation and counting colonies	Incubator and colony counter (a dark room heated to the proper temperature can be used for incubation)	

SCHEDULE OF ACTIVITIES

1. Purchasing the insecticide:
   January and February

2. Choosing the aircraft:
   January and February

3. Mixing facilities:
   January and February
   (when building new facilities is required)

4. Choosing airfields:
   March and April

5. Communications:
   — planification: February and March
   — use: May and June

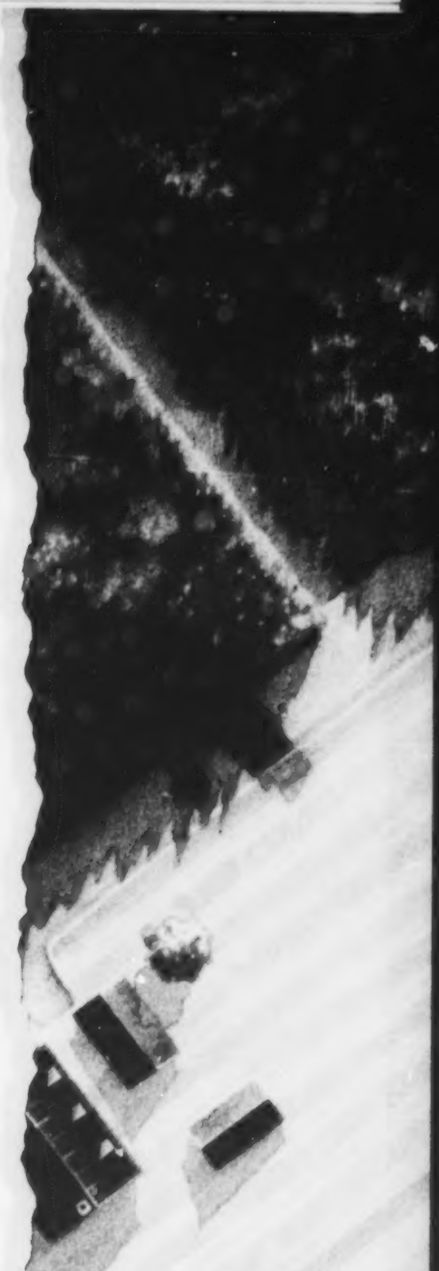
6. Spray periods:
   end of May and June

7. Flight planning:
   — theoretical: March and April
   — operational: May and June

8. Methods of control:
   end of May and June

TECHNICAL LEAFLET 5

ASSESSING LARVAL AND FOLIAGE DEVELOPMENT, DEFOLIATION, AND TREATMENT EFFICIENCY



1. ASSESSING FOLIAGE DEVELOPMENT
    - 1.1 Establishing a network of sampling sites
    - 1.2 Collecting samples
    - 1.3 Bud development
2. ASSESSING INSECT DEVELOPMENT AND TREATMENT EFFICIENCY
    - 2.1 Larval development
    - 2.2 Determining larval population levels
    - 2.3 Determining current year growth defoliation levels
    - 2.4 Determining treatment efficiency
3. ASSESSING POSTTREATMENT POPULATION LEVELS
    - 3.1 Assessing the number of egg masses
    - 3.2 Assessing overwintering L_2 levels

REFERENCES

MATERIAL REQUIRED FOR THIS PHASE OF THE PROTECTION PROGRAM

SCHEDULE OF ACTIVITIES

1. ASSESSING FOLIAGE DEVELOPMENT

1.1 Establishing a network of sampling sites

The sampling site is the basic element of various methods used to assess population and defoliation levels. First, depending on the degree of precision required, the number of sample sites, or plots, required should be determined. When testing a new insecticide or a new spray technology, a sufficient number of samples to obtain a statistical confirmation of the results is required. For routine spraying operations with proven insecticides and spray technologies, it is sufficient to determine the general effect of the treatment compared with surrounding untreated areas. In our program, a minimum of one sample site per block was required with one corresponding sample site in a nearby untreated area. When the block was 1000 ha or over and contained natural obstacles, one sample plot per homogeneous part of the block was recommended. For example, in a block separated into two sections by a river or a multi-level block (valley and mountains), a sample plot was established on each side of the river in the former, and one in the valley and one on the mountain top in the latter. For a block of 1000 ha or over, a minimum of two untreated plots was established.

Design of a sample site

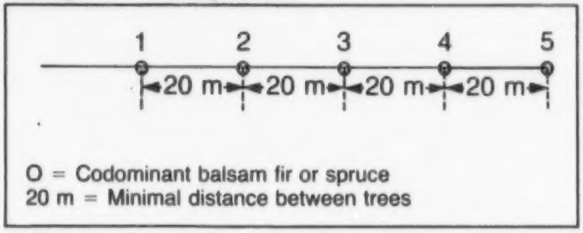

1
2
3
4
5
20 m
20 m
20 m
20 m
O = Codominant balsam fir or spruce
20 m = Minimal distance between trees

Figure 1.
Design of a sample site.

To establish a sampling site, five codominant balsam fir or spruce trees, 20 m apart along a linear axis (Figure 1), were chosen at random.

Although sampling sites were randomly located, certain parameters were considered so that sampling could be done rapidly and efficiently. For example, our sampling sites were easily accessible by roads. Aerial access was possible but costly, while access through rivers and lakes was not considered because it resulted in considerable time loss.

The second criteria to be considered was the characteristics of the sampling sites versus the characteristics of the stand in general. In a mixed stand, the sampling site was established in a mixed forest area and not in pure softwood areas. Therefore, the results obtained were more accurate. Consulting 1: 20 000 forest maps helped define the type of stand accurately and thus meet the objective of establishing representative sample plots.

The third parameter considered was topography. Establishing sampling sites in particularly hilly areas makes sampling more difficult. It should be remembered that in these sites, field workers would have to manipulate pole pruners several metres high. Also, insecticide deposit might be higher than that on flat territory, therefore affecting the exactness of results.

In a treated area, sampling sites were located in sections susceptible to being treated without any particular problems and receiving the desired quantity of pesticide. Sampling sites were established at least 800 m from the limits of treated areas or of environmentally protected areas, which were not treated (Figure 2).

Location of the sample sites in a treated block

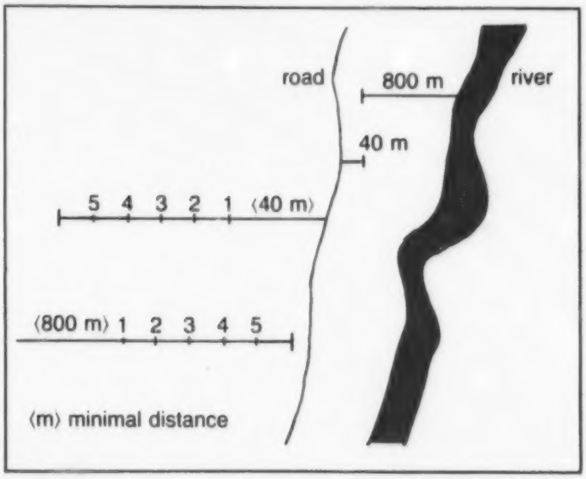


Figure 2.
Location of the sample sites in a treated block.

Sampling sites in treated areas were located along an axis perpendicular to flight lines and selected trees. Choosing trees was also important. Because the first aim of the sampling was to assess treatment efficiency, conifers covered by deciduous trees were not selected; the foliage of some deciduous species had already started to open when spraying against the spruce budworm began. It should be possible to reach the median section of chosen trees with 10-m long pole pruners.

To facilitate the field workers' work, sampling sites were located on 1:50 000 survey maps (Figure 3).

1.2 Collecting samples

All samples for assessing larval development, mortality, or current year growth defoliation were collected from the upper part of the median section of tree crowns (Figure 4).

Branch tips of 45 cm were used to follow larval and bud development and to determine larval population and defoliation levels. When determining the number of egg masses and the level of larvae in hibernation, full-length branches were used. Basket-equipped pole pruners (Figure 5) were used to take one tip per tree for each sample. Each branch was individually sealed in plastic bags along with a record form (Figure 6) indicating:

1. block number (Block no.);
2. sampling area number (S.A. no.);
3. tree number (Tree no.);
4. purpose of sampling (pretreatment, post-treatment, development) (Aim); and
5. date of sampling.

The five bags were subsequently placed in a larger one containing all samples from one sampling site (Figure 7). The samples were then taken to the laboratory for examination. Care must be taken not to expose the bags to the sun because too much or too intense heat will affect the larvae. The bags were placed in the shade of trees and covered with moss. They were picked up on the return trip to the laboratory.

1.3 Bud development

This operation was carried out to determine when to begin treatment. At regular intervals, five 45-cm branch tips were sampled in each sampling site. Balsam fir and white spruce buds were divided into five classes according to their degree of development (Figure 8):

Class 1: Buds are resinous and enclosed in a membrane.

Class 2: Buds are swollen and 10 to 35 percent of the needles are visible.

Class 3: Needles are visible but buds have not begun to flare.

Class 4: Shoots are beginning to elongate and buds are flaring.

Class 5: Shoots are elongated and the foliage has begun to spread out.

Two methods can be used to determine when spraying should begin: the percentage and the bud development index (BDI) (Figure 9).

The first method determines the percentage of buds or shoots in each class. Spraying should start when class 4 has reached its peak, that is when more than 80 percent of the shoots are found in classes 4 and 5.

In the second method, a mathematical value, the bud development index (BDI), is established.

Example:

Growth class	1	2	3	4	5	:	Total
Number of buds/45-cm branch	0	5	15	40	9	:	69

Index calculation: $(1 \times 0) + (2 \times 5) + (3 \times 15) + (4 \times 40) + (5 \times 9) = 260$

$$\text{BDI} = \frac{\text{Sum of products}}{\text{Total number of buds/shoots}} = \frac{260}{69} = 3.76$$

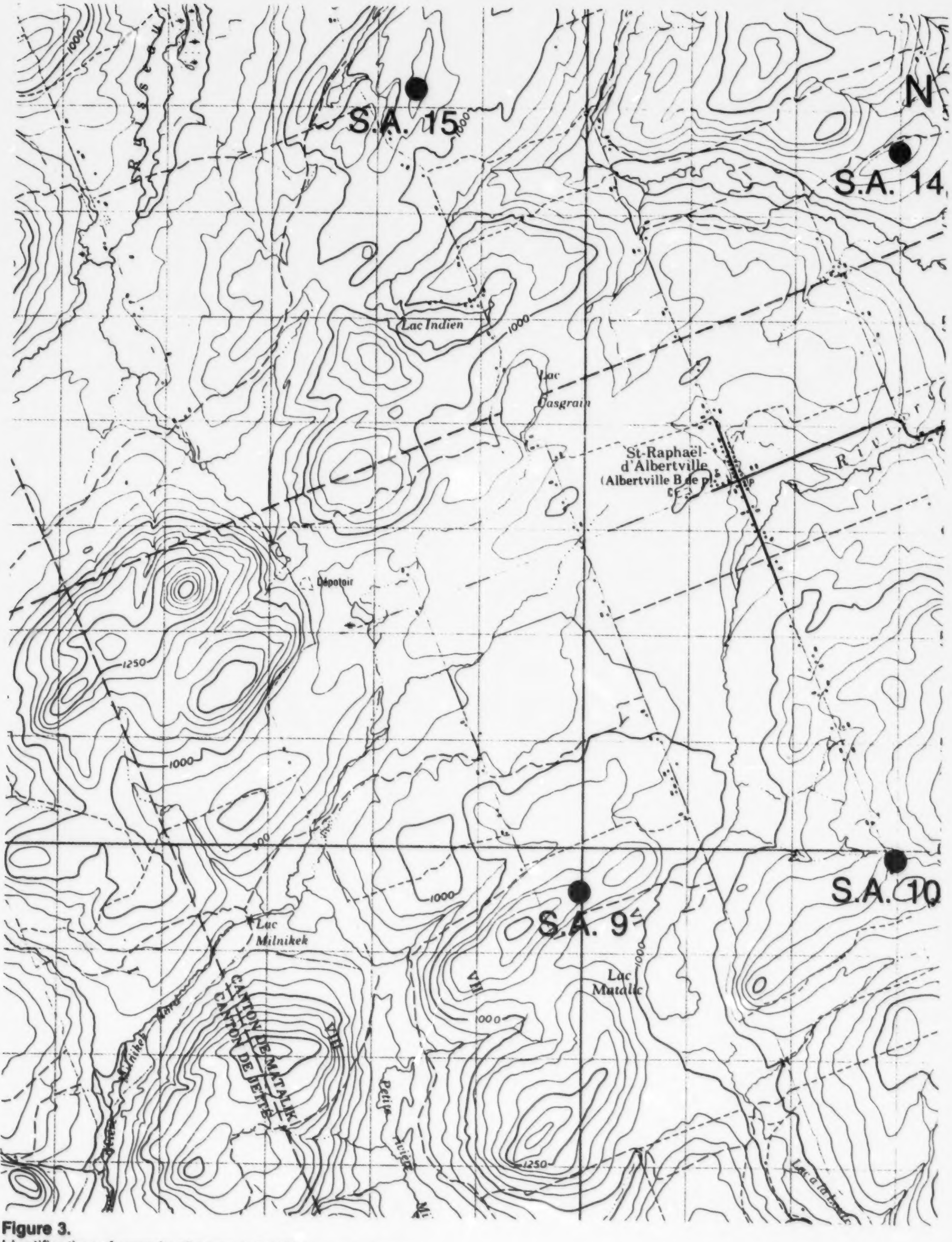

S.A. 15
N
S.A. 14
1000
Lac Indien
Lac Gasgrain
St-Raphaël-d'Albertville
(Albertville B de p)
Rivière
Dépotoir
1250
1000
S.A. 10
S.A. 9
Lac Milnikek
Lac Matalic
CANTON DE MATALIK
CANTON DE JETTÉ
VIII
VII
1000
1250

Figure 3.
Identification of sample sites on 1:50 000 survey maps.

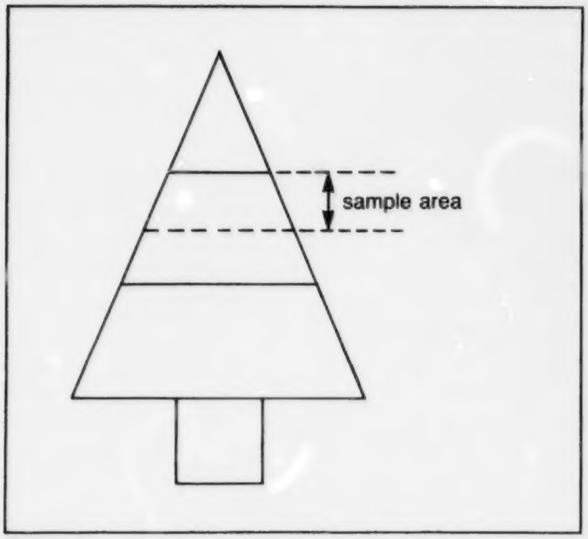
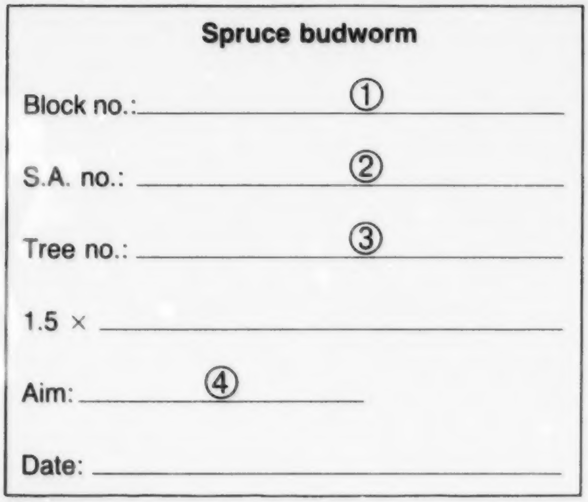


Figure 4.
Location of a sample area in a tree crown.

Figure 5.
Pole pruner and basket for sampling.



Spruce budworm

Block no.: ①

S.A. no.: ②

Tree no.: ③

1.5 ×

Aim: ④

Date:

Figure 6.
Form for identifying samples to be examined in the laboratory.

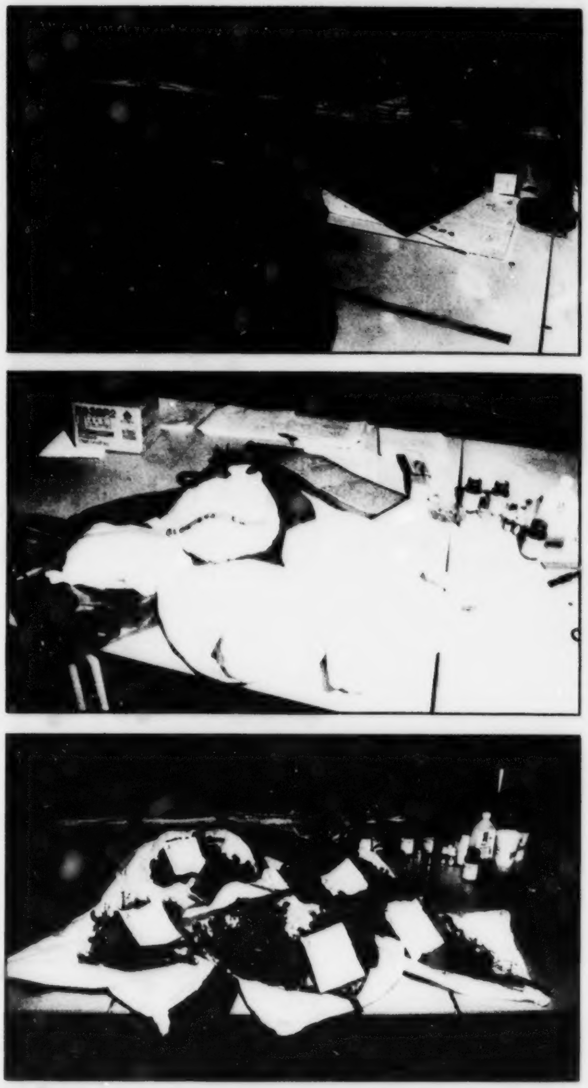
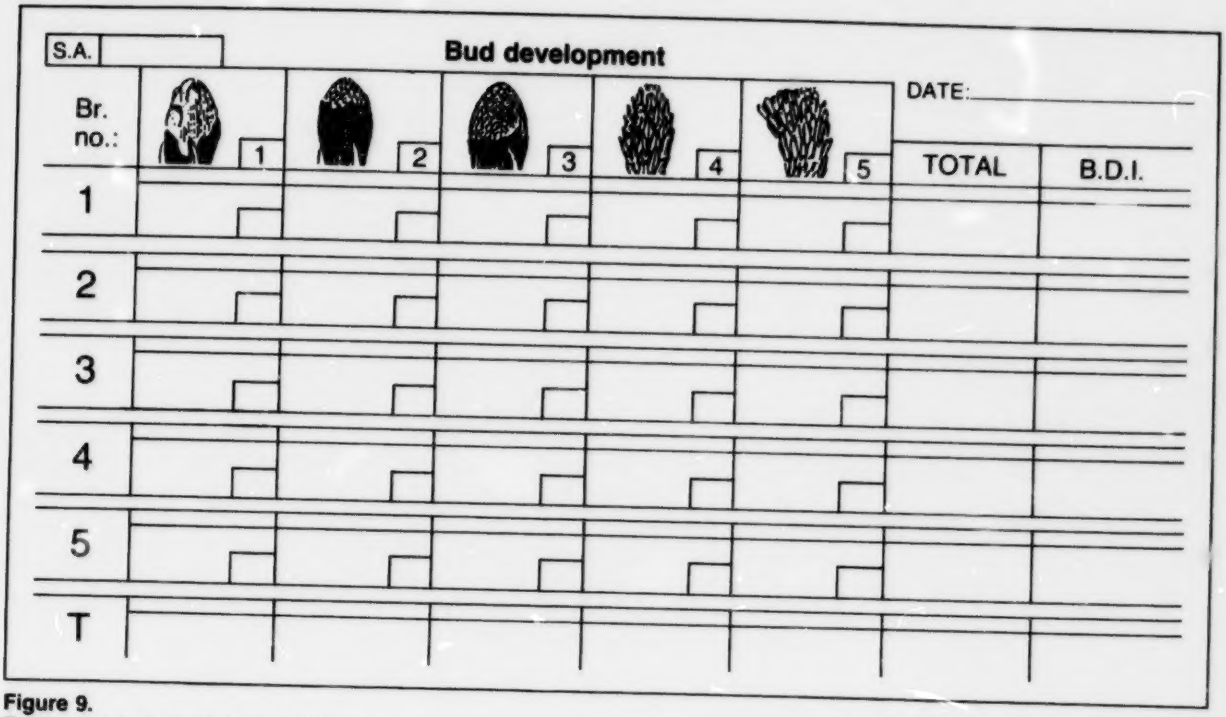


Figure 7.
Identification and wrapping of samples.

Figure 8.
Different stages of bud and shoot development.



S.A.

Bud development

DATE:

Br. no.:	1	2	3	4	5	TOTAL	B.D.I.
1							
2							
3							
4							
5							
T							

Figure 9.
Form used to follow bud development.

For this method, the sum of the products given by the number of buds is multiplied by class number and then divided by the total amount of buds and shoots on a given branch.

Spraying was usually started when the index reached 4.5.

When population levels are high and the treatment schedule condensed (several blocks in an area with similar temperatures where buds are susceptible to open simultaneously), treatment began at BDI 4.0. The BDI percentage used for spraying was based on our operational experience. For example, the beginning of treatment might be advanced in a mixed forest where deciduous trees are able to cover target softwoods and compromise treatment efficiency. The important point was to obtain a maximum number of shoots in categories 4 and 5 for a maximum droplet deposit on the needles before serious damage was caused by the insect.

2. ASSESSING INSECT DEVELOPMENT AND TREATMENT EFFICIENCY

2.1 Larval development

It is essential to assess concurrent larval and bud development. Larval development assessment is to find the synchronism in the insect and bud development phases, and then ensure that spraying is carried out during the period when larvae are most vulnerable, that is before the 5th instar. Synchronism in insect and bud development phases partially explains severe damage of current year growth often registered before treatment at BDI 4.5. Eidt and Cameron (1971) observed a higher larval mortality in an asynchronimous insect-bud situation. We treated spruce budworm when larvae were at peak 3rd instar. Normally, peak 3rd instar larvae coincide with 4.5 BDI for balsam fir. The larval development form (Figure 10) was used to determine the percentage of insects in each class or the larval development index (LDI). Spraying was carried out when 20 percent of the insects were in the

Development

Sample date:________________ Date of examination:______________ S.A.: ________

Insect

Br.	INSTAR						PUPAE		TOTAL
	1	2	3	4	5	6	F	E	
1									
2									
3									
5									
TOTAL									
%									

By: ________________________

Figure 10.
Form used to follow larval development.

second instar (L_2), 70 percent in the third instar (L_3), and 10 percent in the fourth instar (L_4).

Larval instar was determined by measuring the larval head capsules. This method was described by Hardy *et al.* (1972). The following Table illustrates the scale used.

Width of cephalic capsule

Instar	mm	micrometric divisions*
I	<0.250	<10.5
II	0.251 - 0.325	10.5 - 14.5
III	0.326 - 0.500	14.6 - 20.8
IV	0.501 - 0.900	20.9 - 37.5
V♂	0.901 - 1.300	37.6 - 54.2
V♀	1.000 - 1.500	41.7 - 62.5
VI♀	1.300 - 1.850	54.2 - 77.1
VI♂	1.550 - 2.100	64.6 - 87.5

* On stereo microscope, Carl Zeiss IV, equipped with a micrometric disk and used with 10 × oculars and 4 × objective.

To determine the LDI, a number is assigned to each insect instar:

1.0 - I (L_2) (in hibernation)
2.0 - II (L_2) (emerged in the spring)
3.0 - III (L_3)
4.0 - IV (L_4)
5.0 - V♂ (L_5)
6.0 - VI♀ (L_6)
7.0 - VII♀ (Pupa)
8.0 - VIII♂ (Adult) (moth)

Subsequently, the number of insects in each instar is multiplied by the class number. The sum of the product is then divided by the total number of insects on a given branch.

Spraying started when most of the larvae were in the third instar (LDI 3.0). However, the BDI was given priority because this index is sufficiently accurate to determine precisely when treatment should begin, and is more simple to use.

Example:

Reference number	2	3	4	5	6	:	Total
Number of larvae	9	19	7	0	0	:	35

calculation: $(9 \times 2) + (19 \times 3) + (7 \times 4) = 103$

$$\text{LDI} = \frac{\text{Sum of the products}}{\text{Total number of larvae/branch}} = \frac{103}{35} = 2.9$$

2.2 Determining larval population levels

Another larval population level assessment was carried out in the spring. The number of buds per 45-cm branch tip (1) was determined and reported on a form developed for this purpose (Figure 11). Each bud was then examined for larvae. This operation was accomplished by breaking the buds with forceps or dissecting needles as illustrated in Figure 12.

Needles were also examined because some larvae may have been in the needle mines (Figure 13) or crawling to the buds. As an additionnal control, the

Pretreatment

COLLECTED	EXAMINED	I.D.I.		BLOCK:
by:	by:	45 cm	TOTAL	
date:	date:			S.A.:

Larval population

	②	③	②	①	
TREE	LARVAE		LARVAE/BUD		RATIO
	45 cm	total	45 cm	45 cm	Larvae/bud
1					
2					
3					
4					
5					
Total					
Av. Branch.					

(A similar form is used for posttreatment)

Figure 11.
Form used to record larval population levels.

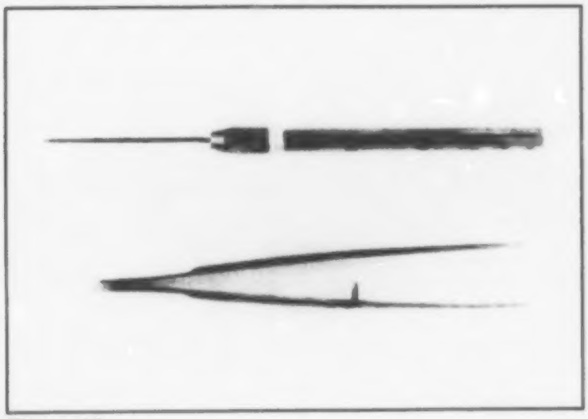


Figure 12.
Forceps and dissecting needles used to extract larvae from buds.

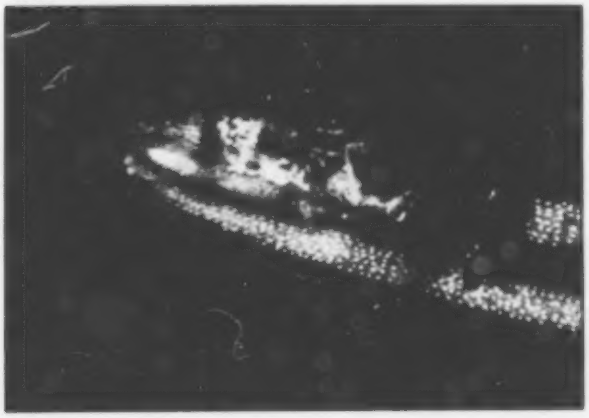
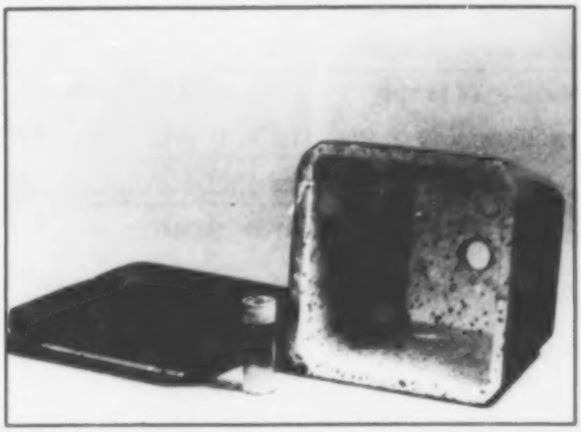


Figure 13.
Mine in a balsam fir needle.

examined foliage was placed in emergence boxes for 5 days (Figure 14). It was observed that up to 20 percent of the larvae were not seen during the first examination. The number of larvae per branch tip was registered (2) (Figure 11). Dividing the figures of column 2 by the figures of column 1 gave the number of larvae per bud. Column 3 was only used to register the number of larvae on a full-length branch. These data were used to determine treatment efficiency and larval mortality. The latter was obtained by subtracting residual population, i.e. the number of insects remaining when 85 percent of the larvae have reached the pupal stage, from pretreatment population.

Larval mortality = (P1 - P2) ÷ P1 × 100 =

P1 = pretreatment population
P2 = posttreatment population



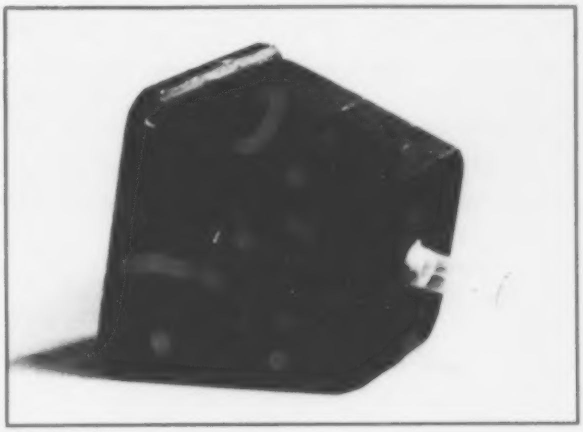
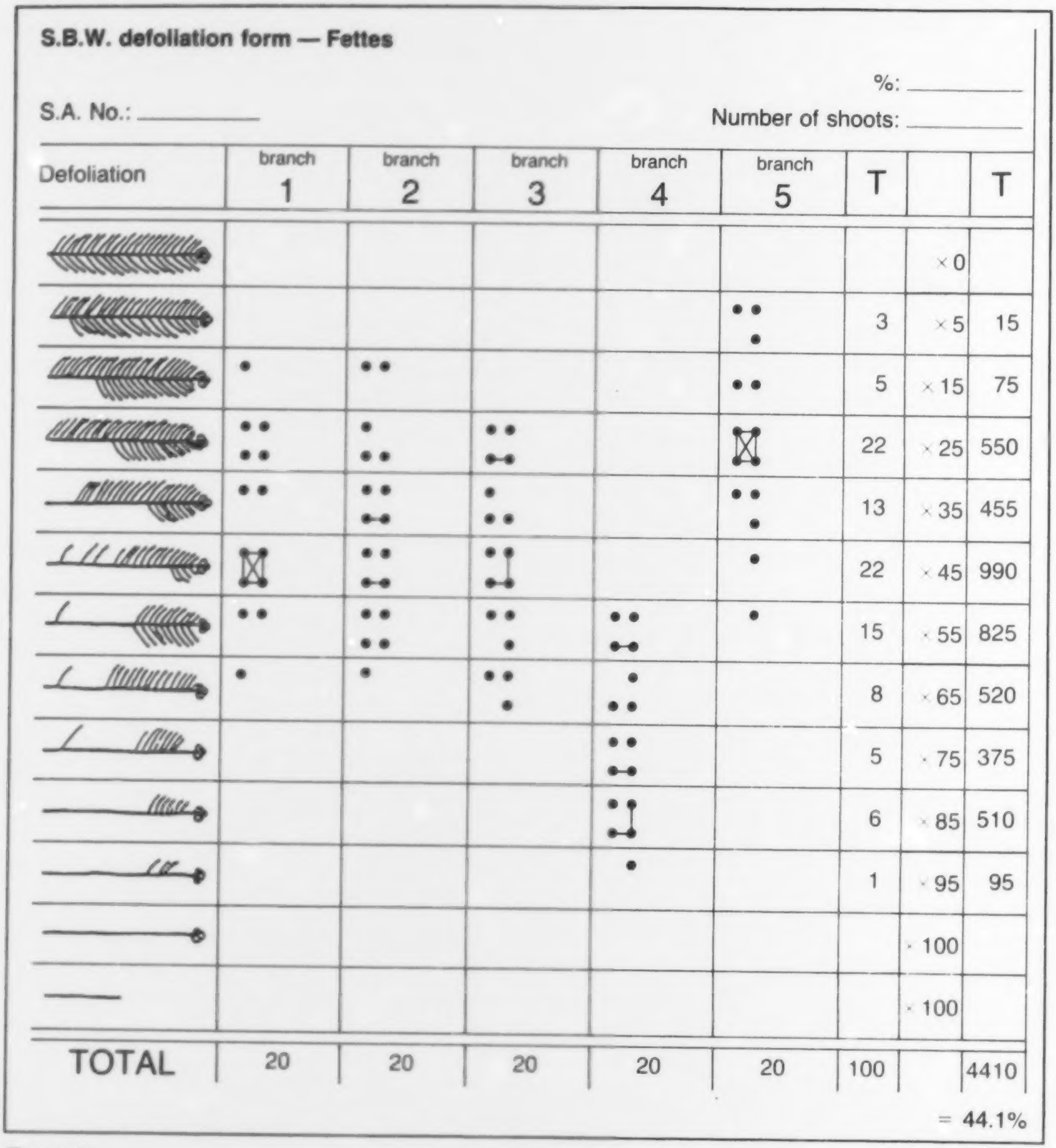


Figure 14.
Cage for larval emergence.

2.3 Determining current year growth defoliation level

The main purpose of treating stands against spruce budworm is to assure foliage protection and tree survival. Therefore, defoliation assessment is of prime importance. Fettes' (1950) method was used to determine current year growth defoliation caused by spruce budworm.

To carry out this assessment, 45-cm balsam fir and white spruce branch tips were collected at the end of the feeding cycle from each of the sample sites. Then, the samples were taken to the laboratory. On each branch, 20 shoots were classified, from the tip to the bottom of the branch, using Fettes' classification (1) which gave values from 0 to 12 corresponding to a percentage value of defoliation (Figure 15). Subsequently, the number of shoots in each class (2) was



S.B.W. defoliation form — Fettes

%: ____________

S.A. No.: ____________

Number of shoots: ____________

Defoliation	branch 1	branch 2	branch 3	branch 4	branch 5	T		T
							× 0	
					●● ●	3	× 5	15
	●	●●			●●	5	× 15	75
	●● ●●	● ●●	●● ●─●		☒	22	× 25	550
	●●	●● ●─●	● ●●		●● ●	13	× 35	455
	☒	●● ●─●	●│● ●─●		●	22	× 45	990
	●●	●● ●●	●● ●	●● ●─●	●	15	× 55	825
	●	●	●● ●	● ●●		8	× 65	520
				●● ●─●		5	× 75	375
				●│● ●─●		6	× 85	510
				●		1	× 95	95
							× 100	
							× 100	
TOTAL	20	20	20	20	20	100		4410

= 44.1%

Figure 15.
Form used to assess current year growth defoliation using the Fettes method.

multiplied by the percent defoliation value of the corresponding class (3). The sum of the results (4) was divided by 100 (20 shoots × 5 branches), which resulted in defoliation of current year growth.

2.4 Determining treatment efficiency

Foliage protection is the primary indicator of treatment efficiency. Larval mortality is also an indicator of treatment efficiency. It consists of establishing the difference between pretreatment and posttreatment populations established at peak pupae — when 85 percent of the pupae are formed. The Abbott (1925) formula, which follows, was used to assess treatment efficiency.

Untreated survivals (M) less treated survivals (m) divided by untreated survivals (M), multiplied by 100.

$$\text{Treatment efficiency} = \frac{M - m}{M} \times 100$$

3. ASSESSING POSTTREATMENT POPULATION LEVELS

3.1 Assessing the number of egg masses

In eastern Quebec, egg laying by the spruce budworm is usually completed by mid-August and larval emergence by the end of the same month.

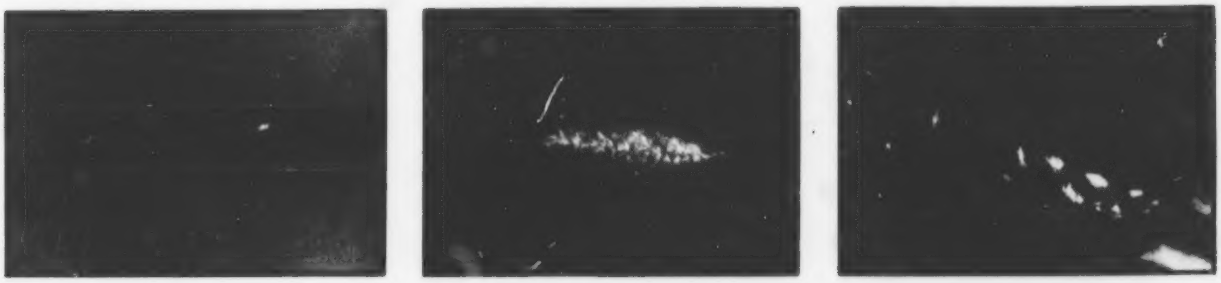
Assessment of egg masses thus began early in September in order to forecast defoliation for the coming year. Full-length branches (along the trunk) were cut at the same height in sample trees. These branches were individually wrapped, properly identified, and taken to the laboratory for examination. The foliage area of each branch was determined. Although there are many methods (Sanders 1980), we measured the length of the branch from its tip to the last living lateral branch (L) and multiplied this by the width of foliage at mid-length (W).

All foliage was then thoroughly examined for egg masses, which resemble small white cloth lines on or under the needles (Figure 16). Occasionally, living egg masses (light green), parasitized egg masses (black), and egg masses from the previous year (dark green or dark grey and longer than either living or parasitized egg masses) were found. It is important to note that previous year and parasitized egg masses were not used in the calculation and were only listed for information. The number of egg masses per surface unit was established and then registered on a special form (Figure 17). According to their number per surface unit, the number of egg masses served to establish the level of defoliation expected for the coming year in the following categories: light, moderate, and severe (Morris 1954, 1955).

3.2 Assessing overwintering L_2 levels

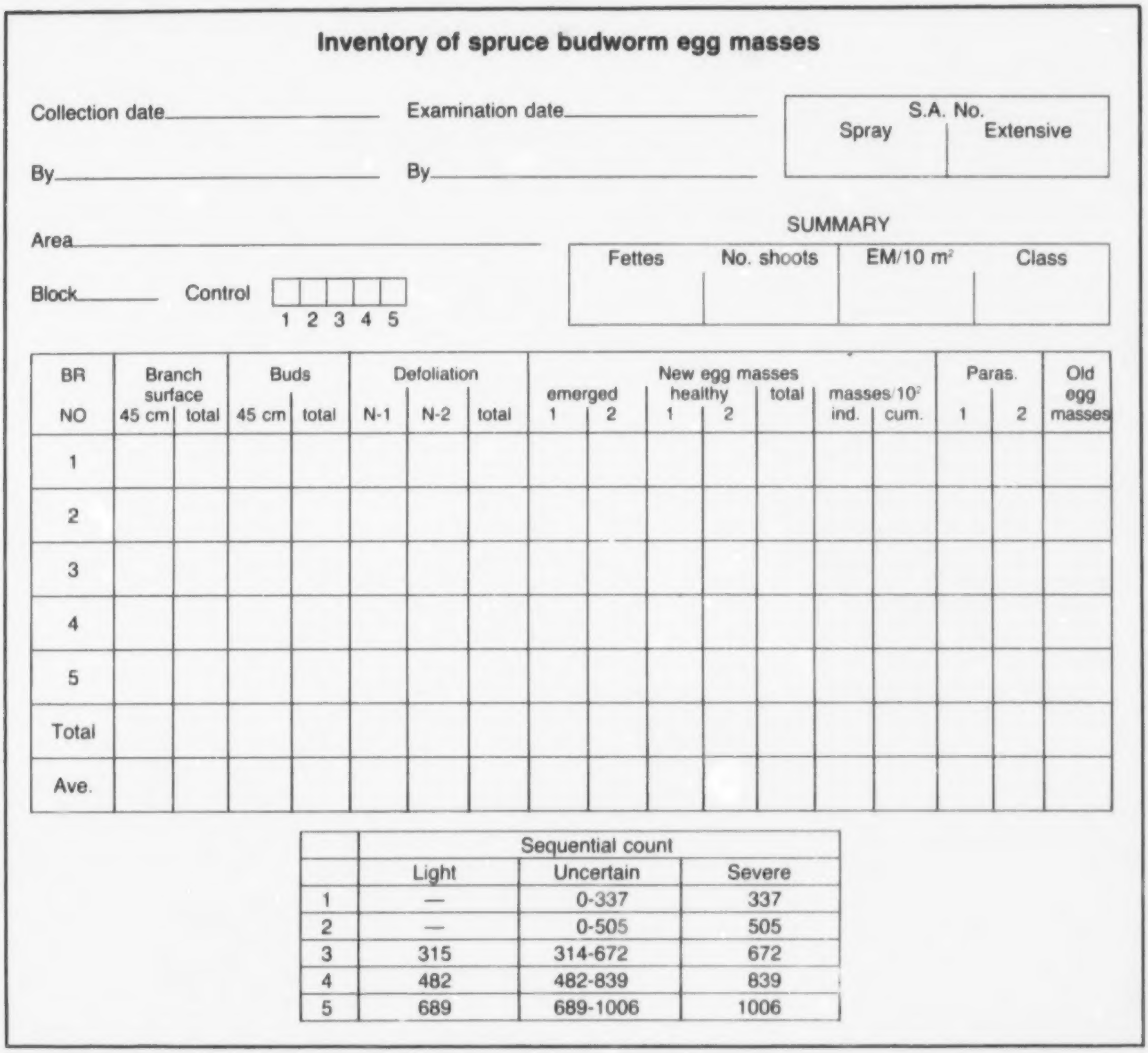
As with egg-mass assessment, full-length branches are required. To minimize time, effort, and money, this sampling was carried out simultaneously with that for egg-mass count. However, these branches must be maintained in optimum conditions (4°C) until they can be examined in the laboratory.

The method used for removing L_2 from needles and branches is known as the "Sodium Hydroxyde Method" and was described by Miller and McDougall (1968), Miller et al. (1971), and Sanders (1980). The Quebec Department of Energy and Resources has also published several booklets on this subject which are available upon request. The method is not described in the present leaflet since it is well described in the above-mentioned papers.



a) healthy b) emerged c) parasitized

Figure 16.
Examples of healthy, emerged, and parasitized egg masses.



Inventory of spruce budworm egg masses

Collection date______________ Examination date______________

By______________ By______________

S.A. No.	
Spray	Extensive

Area______________

Block______ Control ☐☐☐☐☐ 1 2 3 4 5

SUMMARY

Fettes	No. shoots	EM/10 m²	Class

BR	Branch surface		Buds		Defoliation			New egg masses							Paras.		Old egg masses
								emerged		healthy		total	masses/10^2				
NO	45 cm	total	45 cm	total	N-1	N-2	total	1	2	1	2		ind.	cum.	1	2	
1																	
2																	
3																	
4																	
5																	
Total																	
Ave.																	

	Sequential count		
	Light	Uncertain	Severe
1	—	0-337	337
2	—	0-505	505
3	315	314-672	672
4	482	482-839	839
5	689	689-1006	1006

Figure 17.
Form used to assess the number of egg masses and to forecast damages for the coming year.

Essentially, larvae are removed from their hibernaculum on the branches by soaking the branches in a sodium hydroxyde solution (NaOH) and isolating liberated larvae by filtration in order to count them.

As with egg masses, the results were expressed in the number of larvae per foliage area. Defoliation forecasts were expressed as nil, light, moderate, severe, and extremely severe.

The method for determining defoliation forecasts has been reported by Miller et al. (1971). Miller et al. (1972) determined the number of samples required to obtain a given precision.

Number of larvae/10 m²	Index
1 - 188	light
189 - 540	moderate
541 - 1184	severe
1184 - and over	extremely severe

REFERENCES

Abbott, W.S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol. 18: 265-2676.

Eidt, D.C.; Cameron, M.D. 1971. Le débourrement tardif de l'arbre-hôte et la viabilité de la tordeuse des bourgeons de l'épinette. Environ. Can., Rev. Bimes. Rech. 27: 52-53.

Fettes, J.J. 1950. Investigations of sampling techniques for population studies of the spruce budworm on balsam fir in Ontario. *In* Ann. Rep. For. Insect Lab., Sault Ste. Marie, Ontario.

Hardy, Y.; Auger, M.; Caron, M. 1974. Étude du développement de la tordeuse des bourgeons de l'épinette. Bull. techn. No. 2., Serv. Entomol. Pathol., Min. Terres Forêts du Québec.

Miller, C.A.; McDougall, G.A. 1968. A new sampling technique for spruce budworm larvae. Can. Dep. For. Rur. Dev., Bi-mon. Res. Notes 24: 30-31.

Miller, C.A.; Kettela, E.G.; McDougall, G.A. 1971. A sampling technique for overwintering spruce budworm and its applicability to population surveys. Environ. Can., Can. For. Serv., Maritimes For. Res. Cent., Fredericton, N.B. Inf. Rep. M-X-25.

Miller, C.A.; Kettela, E.G.; McDougall, G.A. 1972. Sampling methods in spruce budworm surveys. Environ. Can., Bi-mon. Res. Notes. 28 (5): 31.

Morris, R.F. 1954. A sequential sampling technique for spruce budworm egg surveys. Can. J. Zool. 32: 302-313.

Sanders, C.J. 1980. A summary of current techniques used for sampling spruce budworm populations and estimating defoliation in eastern Canada. Environ. Can., Can. For. Serv., Great Lakes For. Res. Cent., Sault Ste. Marie, Ont., Inf. Rep. O-X-306.

MATERIAL REQUIRED FOR THIS PHASE OF THE PROTECTION PROGRAM

Uses	Material specifications	Suppliers
Establishing sampling plots	Compass, axe, marking tape, fluorescent paint, brush cutter	Suppliers of forest material, camping supplies or hardware
Localization of sample plots	Survey maps 1:50 000	Regional offices, Department of Energy, Mines and Resources Canada
Assessing tree condition	Binocular glasses	Suppliers of optical material or hardware, Fish and Game stores
Transportation for the establishment and sampling of sampling plots	Vehicles	Mileage paid to employees for their vehicles, car rentals
Sampling	Pole pruner	Suppliers of forest material
Bud examination	Forceps, dissecting pick, binoculars, microscope, magnifying lamps, havel magnifier	Scientific supplier
Compilation	Scientific calculators	Local suppliers
Cleaning instruments	Methyl alcohol	Local drugstores
Branch collection	Garbage bags	Local suppliers
Bud examination	Microscope, magnifying lamp	Scientific supplier
Branch collection	Garbage bags	Local suppliers

SCHEDULE OF ACTIVITIES

1. Establishing sampling sites:
   April and May
2. Sample collection:
   May and October
3. Current year growth development:
   May and June
4. Larval development:
   May to July
5. Assessing larval population levels:
   May to July
6. Assessing current year growth defoliation:
   August and September
7. Assessing treatment efficiency:
   August
8. Assessing number of egg masses:
   September
9. Assessing overwintering L_2 levels:
   September and October

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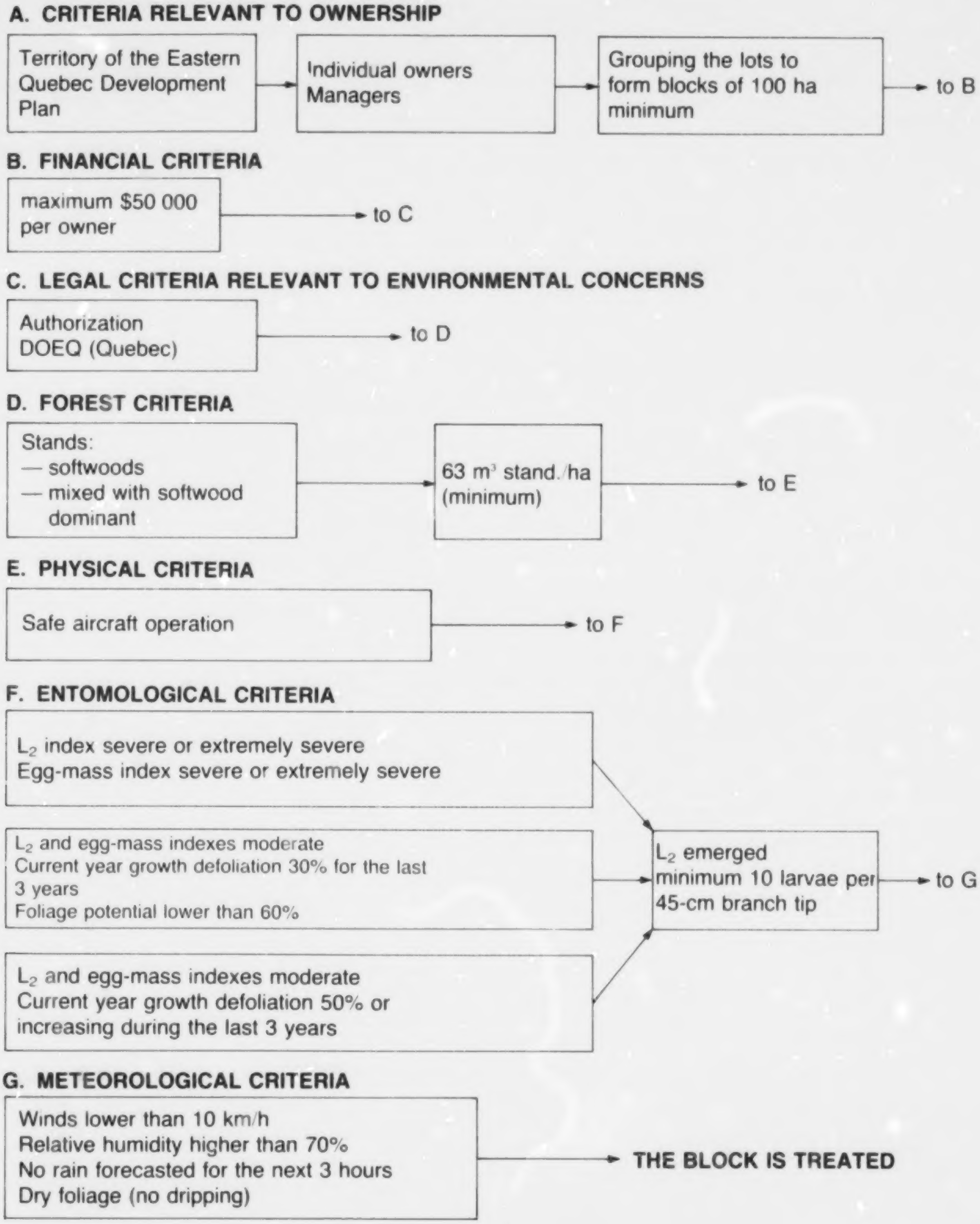
TECHNICAL LEAFLET 1

APPENDIX 1. THE PROCESS USED TO VALIDATE BLOCKS FOR THE PROGRAM FOR AERIAL SPRAYING OF *B.t.* IN PRIVATE FORESTS IN EASTERN QUEBEC

THE PROCESS USED TO VALIDATE BLOCKS FOR THE PROGRAM FOR AERIAL SPRAYING OF *B.t.* IN PRIVATE FORESTS IN EASTERN QUEBEC



A. CRITERIA RELEVANT TO OWNERSHIP

Territory of the Eastern Quebec Development Plan → Individual owners Managers → Grouping the lots to form blocks of 100 ha minimum → to B

B. FINANCIAL CRITERIA

maximum $50 000 per owner → to C

C. LEGAL CRITERIA RELEVANT TO ENVIRONMENTAL CONCERNS

Authorization DOEQ (Quebec) → to D

D. FOREST CRITERIA

Stands:
- softwoods
- mixed with softwood dominant

→ 63 m^3 stand./ha (minimum) → to E

E. PHYSICAL CRITERIA

Safe aircraft operation → to F

F. ENTOMOLOGICAL CRITERIA

L_2 index severe or extremely severe
Egg-mass index severe or extremely severe

L_2 and egg-mass indexes moderate
Current year growth defoliation 30% for the last 3 years
Foliage potential lower than 60%

L_2 and egg-mass indexes moderate
Current year growth defoliation 50% or increasing during the last 3 years

→ L_2 emerged
minimum 10 larvae per 45-cm branch tip → to G

G. METEOROLOGICAL CRITERIA

Winds lower than 10 km/h
Relative humidity higher than 70%
No rain forecasted for the next 3 hours
Dry foliage (no dripping)

→ **THE BLOCK IS TREATED**

TECHNICAL LEAFLET 2

APPENDIX 1. APPLICATION FOR AUTHORIZATION CERTIFICATE PURSUANT TO SECTION 22 OF "THE ENVIRONMENT QUALITY ACT" (RSQ, c Q-2)

APPLICATION FOR CERTIFICATE OF AUTHORIZATION PURSUANT TO SECTION 22 OF THE ENVIRONMENT QUALITY ACT
(RSQ, c Q-2)

1. EXECUTING PARTY

Name: ______________________________

Address: ______________________________

____

Telephone: (___) _____ - ________

2. CONSULTANTS

A) La Pocatière Region Wood Producers'
Marketing Board
204 Fourth Avenue, P.O. Box 760
LA POCATIERE, Quebec
G0R 1Z0
Telephone: (418) 856-4639
Attention: Mr Louis Brunet, Forest Engineer
Project Manager

B) Agriculture Canada
Canadian Forestry Service
180 des Gouverneurs Street
RIMOUSKI, Quebec
G5L 8G1
Telephone: (418) 722-3144
Attention: Mr. Jean-Guy Gagnon, Project Co-ordinator

3. PROJECT TITLE

Program for Aerial Spraying
of Biological Insecticide (Bt) in Private Woodlots

4. LOCATION (see appended map)

LOT NUMBERS	RANGE	TOWNSHIP	MUNICIPALITY	TREATMENT AREA

5. PROJECT OBJECTIVES AND JUSTIFICATIONS

Given that the forested area described in Item 4 is serious affected by the spruce budworm infestation, aerial spraying of biological insecticide is required to protect the lot(s) and/or prolong the recovery period for affected timber volumes.

6. WORK SCHEDULE

MAY-JUNE 1986

7. PRODUCT USED

Name: Bacillus thuringiensis

Manufacturer: CHEMAGRO LTD

Trade name: FUTURA

Registration number (Pest Control Products Act): 17778

Active ingredient (concentration): 14.4 billion international units per litre

Dosage: 1.5 L/ha (twenty billion international units per hectare)

Diluents and additives (nature and percentage):

Water (1.0 L/ha)

Oil (1.56 ml/ha)

Total applied volume: 2.5 L/ha

8. TECHNICAL CHARACTERISTICS

The project's technical characteristics are listed in the document entitled "Programme de pulvérisation aérienne d'insecticide biologique (Bt) en forêt privée [program for aerial spraying of biological insecticide (Bt) in private woodlots]" and prepared by the Canadian Forestry Service, the Lower St. Lawrence Wood Producers' Syndicate, the Gaspé Region Wood Producers' Syndicate and the La Pocatière Region Wood Producers' Marketing Board under the forestry program of the Eastern Quebec Development Plan. The said document constitutes an integral part of this application as if written out herein. It provides a detailed description of the project and its environment, and includes the following elements:

- Identification of the problem;
- Presentation of possible solutions and their environmental impact:
- Justification of the use of pesticides;
- Identification of the pesticides used;
- Justification of the pesticides chosen;
- Location of areas to be treated and sensitive areas (inhabited areas, watercourses, surface water tables and drinking water supplies);
- Zoning of areas to be treated;
- Application and calibration methods;

- Identification of the applicator and its co-ordinates;
- Methods for disposing of surplus pesticide, containers and waste;
- Mitigation measures;
- Emergency plan;
- Safety program;
- Monitoring program;
- Follow-up program;
- Location of operational base, flight lines (operational base-treatment areas, sensitive areas);
- Guidance systems;
- Meteorological conditions (restrictions and measures).

DECLARATION

I, ____________________________________, declare that I am the owner or delegated manager of the property described in Item 4. In the event of the authorization of this project by the Quebec Department of the Environment, I agree that the work shall be conducted in accordance with the information provided in the present application for a certificate of authorization, which includes as an integral part the document entitled "Programme de pulvérisation aérienne d'insecticide biologique (Bt) en forêt privée [program for aerial spraying of biological insecticide (Bt) in private woodlots]" and prepared by the Canadian Forestry Service, the Lower St. Lawrence Wood Producers' Syndicate, the Gaspé Region Wood Producers' Syndicate and the La Pocatière Region Wood Producers' Marketing Board under the forestry program of the Eastern Quebec Development Plan.

Made and signed at ____________________________ this ____________________ 1986.

____

Signature

APPENDIX 2. REQUIREMENTS OF THE QUEBEC DEPARTMENT OF THE ENVIRONMENT FOR ISSUING AUTHORIZATION CERTIFICATES

Certificates of authorization were issued in the name of each of the owners who applied and were subject to the following requirements:

- spraying shall be carried out in accordance with the instructions given on the label of the product used;
- spraying shall be carried out by an air carrier to which the Air Transport Committee (Canadian Transport Commission) has issued a Class 7 AAD (aerial application and distribution) operating certificate;
- the executing party or its agent shall record and maintain files containing the results of the calibration tests required to determine the spraying characteristics of the equipment used;
- the executing party or its agent shall record and maintain files containing the data required to determine the compatibility of the products used, to provide a clear description of the areas treated, and to assess prevailing meteorological conditions during the spraying period (including wind speeds);
- spraying shall be carried out when most of the insect larvae have reached the third or fourth instar;
- a protective perimeter equivalent to the width of one flight line shall be maintained in the area of dwellings, watercourses, surface water reservoirs and drinking water supplies;
- spraying shall be carried out when the relative humidity is higher than seventy percent;
- spraying activities shall be suspended when wind speed exceeds ten kilometres per hour;
- spraying shall not be carried out when rain is forecast;
- empty containers intended for reuse shall be rinsed first; containers to be discarded at an authorized sanitary incineration or below-ground disposal site shall first be rendered unusable;
- during spraying operations, the executing party or its agent shall always have access to material required to deal with an accidental pesticide spill and, in the event of such a spill, shall follow the procedure outlined in the application;
- the executing party or its agent shall, in accordance with the procedures outlined in the application, monitor the work to ensure its compliance with the specifications set out in the certificate of authorization;
- the executing party or its agent shall conduct a follow-up assessment of the project results;
- the executing party or its agent shall, by means of releases published in the local and regional press, inform the population concerned of the purpose of the spraying, the location and size of the areas to be sprayed and the probable spraying schedule;
- the executing party or its agent shall allow staff of the Quebec Department of the Environment access to the work sites for purposes of monitoring and follow-up of the spraying program;
- the executing party or its agent shall set up a radiocommunications system for exchanging information with the pilot and, if necessary, giving him or her instructions;
- the executing party or its agent shall set up a guidance system to eliminate overlapping of flight lines and ensure that areas to be excluded from treatment are not sprayed;
- the executing party or its agent shall set up the safety program described in the application in order to ensure the safety of workers; and
- the executing party or its agent shall submit to the Department of the Environment a work report indicating the extent to which spraying took place as expected, any difficulties encountered and the corrective action taken. This report shall also include a summary of the monitoring and follow-up activities conducted by the executing party as well as an assessment of the results of the spraying.

APPENDIX 3. ENVIRONMENTAL ASSESSMENT AND REVIEW PROCESS GUIDELINES

Source: Privy Council Office of Canada

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CANADA

(*Extract from the* Canada Gazette *Part II, dated July 11, 1984*)

Registration
SOR/84-467 22 June, 1984

GOVERNMENT ORGANIZATION ACT, 1979

Environmental Assessment and Review Process Guidelines Order

P.C. 1984-2132 21 June, 1984

Her Excellency the Governor General in Council, on the recommendation of the Minister of the Environment, pursuant to subsection 6(2) of the Government Organization Act, 1979*, is pleased hereby to approve the annexed Guidelines respecting the implementation of the federal policy on environmental assessment and review, made by the Minister of the Environment on June 11, 1984.

GUIDELINES RESPECTING THE IMPLEMENTATION OF THE FEDERAL POLICY ON ENVIRONMENTAL ASSESSMENT AND REVIEW

Short Title

1. These Guidelines may be cited as the *Environmental Assessment and Review Process Guidelines Order*.

Interpretation

2. In these Guidelines,

"Environmental Impact Statement" means a documented assessment of the environmental consequences of any proposal expected to have significant environmental consequences that is prepared or procured by the proponent in accordance with guidelines established by a Panel; (*énoncé des incidences environnementales*)

"department" means, subject to sections 7 and 8,

(*Extrait de la* Gazette du Canada *Partie II, en date du 11 juillet 1984*)

Enregistrement
DORS/84-467 22 juin 1984

LOI DE 1979 SUR L'ORGANISATION DU GOUVERNEMENT

Décret sur les lignes directrices visant le processus d'évaluation et d'examen en matière d'environnement

C.P 1984-2132 21 juin 1984

Sur avis conforme du ministre de l'Environnement et en vertu du paragraphe 6(2) de la Loi de 1979 sur l'organisation du gouvernement*, il plaît à Son Excellence le Gouverneur général en conseil d'approuver, conformément à l'annexe ci-après, le Décret sur les lignes directrices visant la mise en œuvre du processus fédéral d'évaluation et d'examen en matière d'environnement pris par le ministre de l'Environnement le 11 juin 1984.

DÉCRET SUR LES LIGNES DIRECTRICES VISANT LA MISE EN ŒUVRE DU PROCESSUS FÉDÉRAL D'ÉVALUATION ET D'EXAMEN EN MATIÈRE D'ENVIRONNEMENT

Titre abrégé

1. *Décret sur les lignes directrices visant le processus d'évaluation et d'examen en matière d'environnement.*

Définitions

2. Les définitions qui suivent s'appliquent aux présentes lignes directrices.

«Bureau» Le Bureau fédéral d'examen des évaluations environnementales chargé d'administrer le processus et relevant directement du Ministre. (*Office*)

«commission» Commission d'évaluation environnementale chargée, en vertu de l'article 21, de réaliser l'examen public d'une proposition. (*Panel*)

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* S.C. 1978-79, c. 13, s. 14

* S.C. 1978-79, c. 13, art. 14

(*a*) any department, board or agency of the Government of Canada, and

(*b*) any corporation listed in Schedule D to the *Financial Administration Act* and any regulatory body;

(*ministère*)

"initiating department" means any department that is, on behalf of the Government of Canada, the decision making authority for a proposal; (*ministère responsable*)

"Minister" means the Minister of the Environment; (*Ministre*)

"Office" means the Federal Environmental Assessment Review Office that is responsible directly to the Minister for the administration of the Process; (*Bureau*)

"Panel" means an Environmental Assessment Panel that conducts the public review of a proposal pursuant to section 21; (*commission*)

"Process" means the Environmental Assessment and Review Process administered by the Office; (*processus*)

"proponent" means the organization or the initiating department intending to undertake a proposal; (*promoteur*)

"proposal" includes any initiative, undertaking or activity for which the Government of Canada has a decision making responsibility. (*proposition*)

«énoncé des incidences environnementales» Évaluation détaillée des répercussions environnementales de toute proposition dont les effets prévus sur l'environnement sont importants, qui est effectuée ou fournie par le promoteur en conformité avec les directives établies par une commission. (*Environmental Impact Statement*)

«ministère» S'entend:

a) de tout ministère, commission ou organisme fédéraux, ou

b) dans les cas indiqués, l'une des corporations de la Couronne nommées à l'annexe D de la *Loi sur l'administration financière* ou tout organisme de réglementation.

(*department*)

«ministère responsable» Ministère qui, au nom du gouvernement du Canada, exerce le pouvoir de décision à l'égard d'une proposition. (*initiating department*)

«Ministre» Le ministre de l'Environnement. (*Minister*)

«processus» Le processus d'évaluation et d'examen en matière d'environnement, administré par le Bureau. (*Process*)

«promoteur» L'organisme ou le ministère responsable qui se propose de réaliser une proposition. (*proponent*)

«proposition» S'entend en outre de toute entreprise ou activité à l'égard de laquelle le gouvernement du Canada participe à la prise de décisions. (*proposal*)

Scope

3. The Process shall be a self assessment process under which the initiating department shall, as early in the planning process as possible and before irrevocable decisions are taken, ensure that the environmental implications of all proposals for which it is the decision making authority are fully considered and where the implications are significant, refer the proposal to the Minister for public review by a Panel.

4. (1) An initiating department shall include in its consideration of a proposal pursuant to section 3

(*a*) the potential environmental effects of the proposal and the social effects directly related to those environmental effects, including any effects that are external to Canadian territory; and

(*b*) the concerns of the public regarding the proposal and its potential environmental effects.

(2) Subject to the approval of the Minister and the Minister of the initiating department, consideration of a proposal may include such matters as the general socio-economic effects of the proposal and the technology assessment of and need for the proposal.

5. (1) Where a proposal is subject to environmental regulation, independently of the Process, duplication in terms of public reviews is to be avoided.

(2) For the purpose of avoiding the duplication referred to in subsection (1), the initiating department shall use a public review under the Process as a planning tool at the earliest stages of development of the proposal rather than as a regulatory mechanism and make the results of the public review

Portée

3. Le processus est une méthode d'auto-évaluation selon laquelle le ministère responsable examine, le plus tôt possible au cours de l'étape de planification et avant de prendre des décisions irrévocables, les répercussions environnementales de toutes les propositions à l'égard desquelles il exerce le pouvoir de décision.

4.(1) Lors de l'examen d'une proposition selon l'article 3, le ministère responsable étudie:

a) les effets possibles de la proposition sur l'environnement ainsi que les répercussions sociales directement liées à ces effets, tant à l'intérieur qu'à l'extérieur du territoire canadien; et

b) les préoccupations du public qui concernent la proposition et ses effets possibles sur l'environnement.

(2) Sous réserve de l'approbation du Ministre et du ministre chargé du ministère responsable, il doit être tenu compte lors de l'étude d'une proposition de questions telles que les effets socio-économiques de la proposition, l'évaluation de la technologie relative à la proposition et le caractère nécessaire de la proposition.

5.(1) Si, indépendamment du processus, le ministère responsable soumet une proposition à un règlement sur l'environnement, il doit veiller à ce que les examens publics ne fassent pas double emploi.

(2) Pour éviter la situation de double emploi visée au paragraphe (1), le ministère responsable doit se servir du processus d'examen public comme instrument de travail au cours des premières étapes du développement d'une proposition plutôt que comme mécanisme réglementaire, et rendre les résultats

available for use in any regulatory deliberations respecting the proposal.

Application

6. These Guidelines shall apply to any proposal

(*a*) that is to be undertaken directly by an initiating department;

(*b*) that may have an environmental effect on an area of federal responsibility;

(*c*) for which the Government of Canada makes a financial commitment; or

(*d*) that is located on lands, including the offshore, that are administered by the Government of Canada.

7. Where the decision making authority for a proposal is a corporation listed in Schedule D to the *Financial Administration Act*, the Process shall apply to that proposal only if

(*a*) it is the corporate policy of that corporation to apply the Process; and

(*b*) the application of the Process to that proposal is within the legislative authority of that corporation.

8. Where a board or an agency of the Government of Canada or a regulatory body has a regulatory function in respect of a proposal, these Guidelines shall apply to that board, agency or body only if there is no legal impediment to or duplication resulting from the application of these Guidelines.

9. (1) Where, in respect of a proposal, there are two or more initiating departments, the initiating departments shall determine which of the responsibilities, duties and functions of an initiating department under these Guidelines shall apply to each of them.

(2) Where the initiating departments cannot under subsection (1) agree to a determination, the Office shall act as an arbitrator in the making of the determination.

INITIAL ASSESSMENT

Initiating Department

10.(1) Every initiating department shall ensure that each proposal for which it is the decision making authority shall be subject to an environmental screening or initial assessment to determine whether, and the extent to which, there may be any potentially adverse environmental effects from the proposal.

(2) Any decisions to be made as a result of the environmental screening or initial assessment referred to in subsection (1) shall be made by the initiating department and not delegated to any other body.

11. For the purposes of the environmental screening and initial assessment referred to in subsection 10(1), the initiating department shall develop, in cooperation with the Office,

(*a*) a list identifying the types of proposals that would not produce any adverse environmental effects and that would, as a result, be automatically excluded from the Process; and

de l'examen public disponibles aux fins des délibérations de nature réglementaire portant sur la proposition.

Champ d'application

6. Les présentes lignes directrices s'appliquent aux propositions

a) devant être réalisées directement par un ministère responsable;

b) pouvant avoir des répercussions environnementales sur une question de compétence fédérale;

c) pour lesquelles le gouvernement du Canada s'engage financièrement; ou

d) devant être réalisées sur des terres administrées par le gouvernement du Canada, y compris la haute mer.

7. Lorsqu'une corporation nommée à l'annexe D de la *Loi sur l'administration financière* exerce le pouvoir de décision relativement à une proposition, le processus ne s'applique à la proposition que si la corporation:

a) a comme politique générale d'appliquer le processus; et

b) est habilitée à appliquer le processus à cette proposition.

8. Lorsqu'une commission ou un organisme fédéral ou un organisme de réglementation exerce un pouvoir de réglementation à l'égard d'une proposition, les présentes lignes directrices ne s'appliquent à la commission ou à l'organisme que si aucun obstacle juridique ne l'empêche ou s'il n'en découle pas de chevauchement des responsabilités.

9. (1) Lorsqu'il y a plus d'un ministère responsable à l'égard d'une proposition, ceux-ci décident entre eux de la répartition des fonctions et des responsabilités que les présentes lignes directrices attribuent à un ministère responsable.

(2) Lorsque les ministères responsables visés au paragraphe (1) ne peuvent en arriver à une décision unanime, le Bureau agit à titre d'arbitre dans la prise de la décision.

ÉVALUATION INITIALE

Le ministère responsable

10. (1) Le ministère responsable s'assure que chaque proposition à l'égard de laquelle il exerce le pouvoir de décision est soumise à un examen préalable ou à une évaluation initiale, afin de déterminer la nature et l'étendue des effets néfastes qu'elle peut avoir sur l'environnement.

(2) Les décisions qui font suite à l'examen préalable ou à l'évaluation initiale visés au paragraphe (1) sont prises par le ministère responsable et ne peuvent être déléguées à nul autre organisme.

11. Aux fins de l'examen préalable et de l'évaluation initiale visés au paragraphe 10(1), le ministère responsable dresse, en collaboration avec le Bureau, les listes suivantes:

a) une liste des divers types de propositions qui n'auraient aucun effet néfaste sur l'environnement et qui, par conséquent, seraient automatiquement exclus du processus; et

(*b*) a list identifying the types of proposals that would produce significant adverse environmental effects and that would be automatically referred to the Minister for public review by a Panel.

12. Every initiating department shall screen or assess each proposal for which it is the decision making authority to determine if

(*a*) the proposal is of a type identified by the list described under paragraph 11(*a*), in which case the proposal may automatically proceed;

(*b*) the proposal is of a type identified by the list described under paragraph 11(*b*), in which case the proposal shall be referred to the Minister for public review by a Panel;

(*c*) the potentially adverse environmental effects that may be caused by the proposal are insignificant or mitigable with known technology, in which case the proposal may proceed or proceed with the mitigation, as the case may be;

(*d*) the potentially adverse environmental effects that may be caused by the proposal are unknown, in which case the proposal shall either require further study and subsequent rescreening or reassessment or be referred to the Minister for public review by a Panel;

(*e*) the potentially adverse environmental effects that may be caused by the proposal are significant, as determined in accordance with criteria developed by the Office in cooperation with the initiating department, in which case the proposal shall be referred to the Minister for public review by a Panel; or

(*f*) the potentially adverse environmental effects that may be caused by the proposal are unacceptable, in which case the proposal shall either be modified and subsequently rescreened or reassessed or be abandoned.

13. Notwithstanding the determination concerning a proposal made pursuant to section 12, if public concern about the proposal is such that a public review is desirable, the initiating department shall refer the proposal to the Minister for public review by a Panel.

14. Where, in any case, the initiating department determines that mitigation or compensation measures could prevent any of the potentially adverse environmental effects of a proposal from becoming significant, the initiating department shall ensure that such measures are implemented.

15. The initiating department shall ensure

(*a*) after a determination concerning a proposal has been made pursuant to section 12 or a referral concerning the proposal has been made pursuant to section 13, and

(*b*) before any mitigation or compensation measures are implemented pursuant to section 13,

that the public have access to the information on and the opportunity to respond to the proposal in accordance with the spirit and principles of the *Access to Information Act*.

16. The initiating department, in consultation with the Office, shall establish written procedures to be followed in

b) une liste des divers types de propositions qui auraient des effets néfastes importants sur l'environnement et qui seraient automatiquement soumises au Ministre pour qu'un examen public soit mené par une commission.

12. Le ministère responsable examine ou évalue chaque proposition à l'égard de laquelle il exerce le pouvoir de décision, afin de déterminer:

a) si la proposition est d'un type compris dans la liste visée à l'alinéa 11*a*), auquel cas elle est réalisée telle que prévue;

b) la proposition est d'un type compris dans la liste visée à l'alinéa 11*b*), auquel cas elle est soumise au Ministre pour qu'un examen public soit mené par une commission;

c) si les effets néfastes que la proposition peut avoir sur l'environnement sont minimes ou peuvent être atténués par l'application de mesures techniques connues, auquel cas la proposition est réalisée telle que prévue ou à l'aide de ces mesures, selon le cas;

d) si les effets néfastes que la proposition peut avoir sur l'environnement sont inconnus, auquel cas la proposition est soumise à d'autres études suivies d'un autre examen ou évaluation initiale, ou est soumise au Ministre pour qu'un examen public soit mené par une commission;

e) si, selon les critères établis par le Bureau, de concert avec le ministère responsable, les effets néfastes que la proposition peut avoir sur l'environnement sont importants, auquel cas la proposition est soumise au Ministre pour qu'un examen public soit mené par une commission; ou

f) si les effets néfastes que la proposition peut avoir sur l'environnement sont inacceptables, auquel cas la proposition est soit annulée, soit modifiée et soumise à un nouvel examen ou évaluation initiale.

13. Nonobstant la détermination des effets d'une proposition, faite conformément à l'article 12, le ministère responsable soumet la proposition au Ministre en vue de la tenue d'un examen public par une commission, chaque fois que les préoccupations du public au sujet de la proposition rendent un tel examen souhaitable.

14. Le ministère responsable voit à la mise en application de mesures d'atténuation et d'indemnisation, s'il est d'avis que celles-ci peuvent empêcher que les effets néfastes d'une proposition sur l'environnement prennent de l'ampleur.

15. Le ministère responsable doit s'assurer

a) après qu'une détermination sur les effets d'une proposition a été faite conformément à l'article 12 ou après qu'une proposition a été soumise au Ministre conformément à l'article 13, et

b) avant la mise en application de mesures d'atténuation et d'indemnisation conformément à l'article 14,

que le public a accès à l'information concernant cette proposition conformément à la *Loi sur l'accès à l'information*.

16 Le ministère responsable, de concert avec le Bureau, établit par écrit les procédures à suivre pour la détermination des

order to make a determination under section 12 and shall provide the Office on a regular basis, with information, on its implementation of the Process with respect to the proposals for which it is the decision making authority.

17. The initiating department shall

(*a*) ensure that federal-provincial, territorial and international agreements reflect the principles of the Process with respect to proposals for which it is the decision making authority; and

(*b*) include in its program forecasts and annual estimates of the resources necessary to carry out the Process with respect to proposals.

Federal Environmental Assessment Review Office

18. It is the responsibility of the Office to

(*a*) provide initiating departments with procedural guidelines for the screening of proposals and to provide general assistance for the development and installation of implementation procedures;

(*b*) assist the initiating department in the provision of information on and the solicitation of public response to proposals early enough in the planning stage that irrevocable decisions will not be taken before public opinion is heard;

(*c*) publish in summary form the public information provided to the Office by an initiating department on proposals for which it is the decision making authority and for which a determination under section 12 has been made; and

(*d*) inform the Minister on a periodic basis, in a report to be made public, on the implementation of the Process by initiating departments.

Other Departments

19. It is the role of every department that has specialist knowledge or responsibilities relevant to a proposal to

(*a*) provide to the initiating department any available data, information or advice that the initiating department may request concerning

(i) any regulatory requirements related to the project, and

(ii) the environmental effects and the directly related social impact of those effects; and

(*b*) as appropriate, advocate the protection of the interests for which it is responsible.

Public Review

20. Where a determination concerning a proposal is made pursuant to paragraph 12(*b*), (*d*) or (*e*) or section 13, the initiating department shall refer the proposal to the Minister for public review.

21. The public review of a proposal under section 20 shall be conducted by an Environmental Assessment Panel, the members of which shall be appointed by the Minister.

effets d'une proposition selon l'article 12 et fournit régulièrement au Bureau des renseignements concernant l'application du processus aux propositions à l'égard desquelles il exerce le pouvoir de décision.

17. Le ministère responsable:

a) s'assure que les ententes des services fédéraux avec les provinces, les territoires et d'autres pays sont en accord avec les principes du processus, en ce qui concerne les propositions à l'égard desquelles il exerce le pouvoir de décision; et

b) inscrit dans ses prévisions de programmes et ses budgets annuels les ressources nécessaires à l'application du processus à ces propositions.

Bureau fédéral d'examen des évaluations environnementales

18. Il incombe au Bureau

a) d'émettre à l'intention des ministères responsables, des lignes directrices pour l'évaluation initiale des propositions et pour aider ces ministères à instaurer des procédures d'application du processus;

b) d'aider les ministères responsables dans la prestation de renseignements et l'obtention de la réaction du public aux propositions, assez tôt au cours de l'étape de planification pour s'assurer que des décisions irrévocables ne sont pas prises avant que l'opinion du public soit entendue;

c) de publier, sous forme de résumé, l'information publique qui lui a été fournie par les ministères responsables au sujet des propositions à l'égard desquelles ces derniers exercent le pouvoir de décision et dont les effets sur l'environnement ont été déterminés conformément à l'article 12; et

d) d'informer le Ministre au moyen d'un rapport périodique à rendre public, au sujet de la mise en application du processus par les ministères responsables.

Autres ministères

19. Il incombe à tout ministère à vocation spécialisée ou ayant des responsabilités à une proposition donnée:

a) de fournir au ministère responsable, sur demande, des données, des renseignements ou des avis concernant:

(i) les exigences réglementaires afférentes à la proposition, et

(ii) les effets de la proposition sur l'environnement ainsi que les répercussions sociales qui y sont directement liées; et

b) au besoin, de proposer des mesures de protection pour les ressources renouvelables dont il a la responsabilité.

Examens publics

20. Lorsque les effets d'une proposition ont été déterminés conformément aux alinéas 12*b*), *d*) ou *e*) ou à l'article 13, le ministère responsable soumet la proposition au Ministre pour examen public.

21. L'examen public visé à l'article 20 est réalisé par une commission d'évaluation environnementale dont les membres sont nommés par le Ministre.

22. The members of a Panel shall

(*a*) be unbiased and free of any potential conflict of interest relative to the proposal under review;

(*b*) be free of any political influence; and

(*c*) have special knowledge and experience relevant to the anticipated technical, environmental and social effects of the proposal under review.

23. (1) The Executive Chairman of the Office or his delegate shall be the Chairman of a Panel unless, in the opinion of the Minister, the circumstances of a particular review deem it inappropriate.

(2) The Executive Chairman of the Office shall appoint the Executive Secretary of the Panel.

24. The Office shall provide a Panel with

(*a*) any support staff that it may require; and

(*b*) any logistical and administrative services that it may require for its public review and for its public information program conducted pursuant to subsection 28(1).

25. (1) The public review of a proposal shall include

(*a*) an examination of the environmental effects of the proposal; and

(*b*) an examination of the directly related social impact of those effects.

(2) The examinations under paragraphs (1)(*a*) and (*b*) shall be conducted by the same Panel.

(3) Subject to the approval of the Minister and the Minister of the initiating department, the scope of the public review of a proposal may include such matters as the general socio-economic effects of the proposal and the technology assessment of and need for the proposal.

26. (1) The Minister, after consultation with the Minister responsible for the initiating department, shall issue the terms of reference outlining the scope of the public review to be undertaken by a Panel.

(2) The Office, in consultation with the initiating department, shall draft the terms of reference referred to in subsection (1).

(3) The terms of reference for a Panel shall be made available to the public.

27. (1) All hearings of a Panel shall be public hearings conducted in a non-judicial and informal but structured manner.

(2) A Panel shall establish, in accordance with procedural guidelines issued by the Office, its own detailed operating procedures.

(3) Witnesses before a Panel may be questioned but may not be sworn or subpeonaed.

(4) A Panel may question the relevancy and content of any information submitted to it.

28. (1) Every Panel shall conduct a public information program to advise the public of its review and to ensure that the

22. Les membres d'une commission doivent:

a) faire preuve d'objectivité et ne pas être dans une situation où il y a risque de conflit d'intérêts quant à la proposition à l'étude;

b) être à l'abri de l'ingérence politique; et

c) posséder des connaissances particulières et une expérience se rapportant aux effets prévus de la proposition sur les plans technique, environnemental et social.

23. (1) Le président de chaque commission est le président exécutif du Bureau ou son délégué, à moins que le Ministre ne le juge pas indiqué en raison des circonstances d'un examen particulier.

(2) Le président exécutif du Bureau nomme le secrétaire exécutif de la commission.

24. Le Bureau fournit à la commission:

a) le personnel de soutien nécessaire; et

b) les services de soutien administratif et matériel dont elle a besoin pour mener son examen public et la campagne d'information visée au paragraphe 28(1).

25. (1) L'examen public d'une proposition comprend:

a) une étude des effets de la proposition sur l'environnement; et

b) une étude des répercussions sociales directement liées à ces effets.

(2) Les études visées aux alinéas (1)*a*) et *b*) sont menées par la même commission.

(3) Sous réserve de l'approbation du Ministre et du ministre chargé du ministère responsable, l'examen public d'une proposition peut porter sur des questions telles que les effets socio-économiques de la proposition, l'évaluation de la technologie et le caractère nécessaire de la proposition.

26. (1) Le Ministre, après consultation avec le ministre chargé du ministère responsable, établit le mandat de chaque commission en précisant la portée de l'examen public qu'elle effectuera.

(2) Le Bureau rédige le mandat visé au paragraphe (1) en consultation avec le ministère responsable.

(3) Le mandat de chaque commission est rendu public.

27. (1) Les audiences d'une commission sont des audiences publiques qui sont menées de manière informelle suivant des règles déterminées mais non judiciaires.

(2) Chaque commission établit une marche à suivre détaillée, conformément aux procédures générales établies par le Bureau.

(3) Les participants aux audiences publiques d'une commission peuvent être interrogés mais non assermentés ni assignés à comparaître.

(4) Une commission peut remettre en question la pertinence et le contenu des renseignements qui lui sont présentés.

28. (1) Chaque commission mène une campagne d'information pour tenir le public au courant de l'examen entrepris et

public has access to all relevant information that any member of the public may request.

(2) The public information program referred to in subsection (1) shall be in addition to any other public information program that may be conducted by a department or a proponent that is specifically relevant to the activities of that department or proponent.

29. (1) All information that is submitted to a Panel shall become public information.

(2) A Panel shall allow the public access to and sufficient time to examine and comment on the information submitted to it prior to a public hearing.

30. (1) Guidelines for the preparation of an Environmental Impact Statement may be issued by a Panel to the proponent in a public review.

(2) For the purpose of developing the guidelines referred to in subsection (1), a Panel may consult the public and any department.

31. (1) At the end of its review, a Panel shall

(*a*) prepare a report containing its conclusions and recommendations for decisions by the appropriate Ministers; and

(*b*) transmit the report referred to in paragraph (*a*) to the Minister and the Minister responsible for the initiating department.

(2) The Minister and the Minister responsible for the initiating department shall make the report available to the public.

32. Any of the requirements or procedures set out in sections 21 to 31 may be varied by the Office in the case of any federal-provincial review or any review that involves special circumstances.

Initiating Department

33. (1) It is the responsibility of the initiating department in a public review to

(*a*) ensure that the responsibilities of the proponent in the review are fulfilled;

(*b*) ensure that its senior officials and staff make presentations and respond to any questions for which it has responsibility;

(*c*) subject to subsection (2), decide, in cooperation with any other department, agency or board of the Government of Canada to whom the recommendations of a Panel are directed, the extent to which the recommendations should become a requirement of the Government of Canada prior to authorizing the commencement of a proposal;

(*d*) subject to subsection (2), ensure, in cooperation with other bodies concerned with the proposal, that any decisions made by the appropriate Ministers as a result of the conclusions and recommendations reached by a Panel from the public review of a proposal are incorporated into the design, construction and operation of that proposal and that suitable

s'assurer qu'il a accès à l'information pertinente qu'il peut demander.

(2) La campagne d'information visée au paragraphe (1) s'ajoute aux programmes d'information publique des ministères ou des promoteurs qui se rapportent directement à leurs activités.

29. (1) Tous les renseignements présentés à une commission sont rendus publics.

(2) La commission doit accorder au public suffisamment de temps pour lui permettre de prendre connaissance des renseignements qu'elle a reçus au sujet d'une poposition et de donner ses commentaires à ce propos.

30. (1) La commission établit à l'intention du promoteur des directives pour l'élaboration d'un énoncé des incidences environnementales.

(2) La commission peut consulter le public et les ministères pour l'élaboration des directives visées au paragraphe (1).

31. (1) Une fois l'examen terminé, la commission:

a) rédige un rapport contenant ses conclusions et les recommandations qu'elle adresse aux ministres responsables; et

b) fait parvenir le rapport visé à l'alinéa *a*) au Ministre et au ministre chargé du ministère responsable.

(2) Le Ministre et le ministre chargé du ministère responsable rendent public le rapport visé à l'alinéa (1)*a*).

32. Le Bureau peut modifier les exigences ou procédures énoncées aux articles 21 à 31, dans les cas d'examens conjoints fédéraux-provinciaux ou lorsque des circonstances spéciales l'exigent.

Le ministère responsable

33. (1) Lors d'un examen public, il incombe au ministère responsable:

a) de s'assurer que le promoteur s'acquitte de ses responsabilités;

b) de prendre les mesures nécessaires pour que ces hauts fonctionnaires et son personnel fassent des présentations et répondent aux questions sur les sujets relevant de sa compétence;

c) sous réserve du paragraphe (2), de décider, en collaboration avec d'autres ministères, commissions ou organismes fédéraux visés par les recommandations de la commission, de la mesure dans laquelle ces recommandations devraient devenir des exigences fédérales avant d'autoriser la mise en œuvre d'une proposition;

d) sous réserve du paragraphe (2), s'assurer, en collaboration avec d'autres organismes responsables, que les décisions prises par les ministres responsables à la lumière des conclusions et des recommandations qu'a formulées une commission à la suite de l'examen public d'une proposition, sont priimplementation, inspection and environmental monitoring programs are established; and

(*e*) subject to subsection (2), determine in what manner the decisions made under paragraph (*c*) and those referred to in paragraph (*d*) are to be made public.

(2) Where the initiating department has a regulatory function in respect of the proposal under review, the responsibilities set out in paragraphs (1)(*c*), (*d*) and (*e*) shall be amended to account for and not to interfere with the decision making responsibilities of that initiating department.

Proponent

34. It is the responsibility of the proponent in a public review to

(*a*) prepare, in accordance with any guidelines established by the Panel pursuant to subsection 30(1), the Environmental Impact Statement and supporting documents;

(*b*) submit to a Panel, in such languages as are determined appropriate by the Panel, sufficient copies of the Statement and documents referred to in paragraph (*a*) as are required for the purposes of the public review;

(*c*) implement a public information program to explain the proposal under review and its potential environmental effects;

(*d*) in the event that the Panel identifies deficiencies in the Statement referred to in paragraph (*a*), provide sufficient copies as are required for the purposes of the public review, such additional information as may be requested by the Panel;

(*e*) ensure that senior officals and expert staff are present at public hearings of the Panel and that they make the appropriate presentations and respond to any questions put to them; and

(*f*) ensure that appropriate post-assessment monitoring, surveillance and reporting, as required by the initiating department, are carried out.

The Federal Environment Assessment Review Office

35. It is the responsibility of the Office in a public review

(*a*) to draft for consideration by the Minister, in consultation with the initiating department, the terms of reference referred to in subsection 26(1);

(*b*) to identify persons as potential members of a Panel and to make contractual arrangements for their services;

(*c*) where appropriate, to negotiate provincial or territorial participation in a public review, federal participation in a provincial review, or any other participation in any other cooperative mechanisms; and

(*d*) provide written procedures, and any other advice and assistance on procedural and policy matters, to ensure that there is procedural and policy consistency between the various public reviews by Panels.

ses en considération dans la conception, la réalisation et l'exploitation de cette proposition et que des programmes appropriés de mise en œuvre, d'inspection et de surveillance environnementale sont établis; et

e) sous réserve du paragraphe (2), de déterminer de quelle façon seront rendues publiques les décisions prises en vertu de l'alinéa *c*) et celles visées à l'alinéa *d*).

(2) Lorsque le ministère responsable a un rôle de réglementation à l'égard de la proposition à l'étude, les responsabilités énoncées aux alinéas (1)*c*), *d*) et *e*) sont modifiées de façon à tenir compte des décisions de ce ministère et à ne pas y nuire.

Le promoteur

34. Lors d'un examen public, il incombe au promoteur:

a) d'élaborer l'énoncé des incidences environnementales et de présenter les documents à l'appui, conformément aux directives établies par la commission selon le paragraphe 30(1);

b) de présenter un nombre suffisant d'exemplaires de l'énoncé des incidences environnementales et des documents visés à l'alinéa *a*), pour l'examen public, dans les langues indiquées déterminées par la commission;

c) de mettre en œuvre un programme d'information publique visant à expliquer la proposition à l'étude et ses effets possibles sur l'environnement;

d) dans les cas où la commission décèle des lacunes dans l'énoncé des incidences environnementales visé à l'alinéa *a*), fournir un nombre suffisant d'exemplaires de l'information supplémentaire, pour l'examen public;

e) s'assurer que les hauts fonctionnaires et le personnel spécialisé assistent aux audiences publiques de la commission et qu'ils fassent les présentations appropriées et répondent aux questions qui leur sont posées; et

f) de veiller à ce qu'après l'évaluation, un contrôle et une surveillance indiqués soient assurés et que les rapports voulus soient présentés, comme que le demande le ministère responsable.

Le Bureau fédéral d'examen des évaluations environnementales

35. Lors d'un examen public, il incombe au Bureau:

a) de rédiger, en consultation avec le ministère responsable, le mandat visé au paragraphe 26(1) pour qu'il soit soumis au Ministre pour étude;

b) de trouver les membres éventuels d'une commission et de prendre des mesures contractuelles pour retenir leurs services;

c) au besoin, de négocier la participation provinciale ou territoriale à l'examen public, la participation fédérale à un examen provincial ou toute autre participation à des mécanismes coopératifs; et

d) de fournir un ensemble de procédures écrites ainsi que des conseils et de l'aide au sujet des questions de procédure et de politique, afin d'assurer l'uniformité sur le plan des procédures et de la politique entre les examens publics des diverses commissions.

Other Departments

36. In a public review, it is the role of every department that has specialist knowledge or responsibilities relevant to a proposal to

(*a*) provide to the Panel and any other participants in the public review any available data, information or advice that is requested from them;

(*b*) provide experts at public hearings of the Panel to make presentations or to respond to questions; and

(*c*) where appropriate, advocate the protection of the interests for which they have responsibility.

EXPLANATORY NOTE

(This note is not part of the Regulation, but is intended only for information purposes.)

These Guidelines set out the requirements and procedures of the federal Environmental Assessment and Review Process and the responsibilities of the participants therein.

Autres ministères

36. Lors d'un examen public, il incombe à tout ministère à vocation spécialisée ou ayant des responsabilités liées à une proposition donnée:

a) de fournir, sur demande, des données, des renseignements et des conseils aux membres de la commission et aux autres participants de l'examen public;

b) d'assurer la présence de spécialistes lors des audiences publiques de la commission afin que ceux-ci fassent des présentations ou répondent à des questions; et

c) d'encourager, au besoin, la protection des intérêts dont il est responsable.

NOTE EXPLICATIVE

(La présente note ne fait pas partie du règlement et n'est publiée qu'à titre d'information)

Cette série de directives décrivent les exigences et les procédures du Processus fédéral d'évaluation et d'examen environnemental ainsi que les responsabilités de ceux qui y participent.

QUEEN'S PRINTER FOR CANADA, OTTAWA, 1984

IMPRIMEUR DE LA REINE POUR LE CANADA, OTTAWA, 1984

APPENDIX 4. FORMS USED TO DRAW UP LISTS OF OWNERS BY BLOCK AND BY ALPHABETICAL ORDER

BLOCK: ____________________

MUNICIPALITY	RANGE	PROPERTY LOT NUMBER	NAME OF OWNER	ADDRESS	TELEPHONE	CONTACTED	MEETING (DATE AND TIME)

NAME AND ADDRESS	BLOCK	MUNICIPALITY	TOWNSHIP	RANGE	LOT	AREA	LETTER	TELEPHONE	SIGNATURE

APPENDIX 5. CRITERIA FOR ESTABLISHING THE ELIGIBILITY OF WOODLOTS FOR THE PROGRAM FOR AERIAL SPRAYING OF *B.t.* IN PRIVATE WOODLOTS IN EASTERN QUEBEC

ELIGIBILITY OF WOODLOTS

The following property is eligible for the protection program:

1. a) Large or small private lots held in good title and subject to a joint plan administered by the wood producers' marketing board and syndicates within the scope of the Eastern Quebec Development Plan, subject to approval by the owner;

   b) properties described in clause 1.a) of Appendix III and covered by a development agreement with a mutual management organization (organisme de gestion en commun (OGC)), subject to approval by the pertinent OGC and the owner.

2. Crown land (Quebec Department of Agriculture, Fish and Food (MAPAQ), Quebec Department of Energy and Resources (MERQ), Quebec Farm Credit Bureau (OCAQ) located within the territory covered by the joint plans administered by the wood producers' marketing board and syndicates within the scope of the Eastern Quebec Development Plan, and for which the usufruct has been transferred to a natural or artificial person acting as delegated manager (location ticket, location lease, farm lease, blocks of intramunicipal lots), subject to approval by the aforementioned delegated manager.

ADDITIONAL CONDITIONS

In addition to being subject to the requirements of the Quebec Department of the Environment, owners may receive protection under this program amounting to a contribution of no more than $ 50,000 ($ 50,000 - $ 40,000 = 1,250 ha), excluding contributions made under other components of the forestry program.

However, the $ 50,000 limit shall not be applied to collectively owned private woodlots (mutual management organization), but to each of the member owners of the aforementioned organization.

Questions regarding the eligibility of a woodlot shall be submitted to and decided by Forestry Canada, Quebec Region.

APPENDIX 6. LETTER SENT TO WOODLOT OWNERS INVITING THEM TO ATTEND AN INFORMATION MEETING

LE SYNDICAT
DES PRODUCTEURS DE BOIS
DE LA GASPÉSIE

March 5, 1985

THE WOODLOT OWNERS
WHOSE LOTS ARE IN
THE IDENTIFIED ZONE

OBJECT: B.T. SPRAYING AGAINST
THE SPRUCE BUDWORM

Dear Sir or Madam:

Last year the Woodproducers Syndicate of Gaspesia, in collaboration with the Canadian Forestry Service, carried out experimental spraying of the biological insecticide B.t. in private forests for the first time in Canada.

B.t. (*Bacillus thuringiensis*) is a biological insecticide which has been used for more than 20 years throughout the world and is completely safe for man, predators, parasites and even bees.

Last year's results were so conclusive (90% mortality of the larva in the treated zones) that the Canadian Forestry Service has signed a new contract which will allow the Woodproducers Syndicate of Gaspesia to offer you the opportunity of protecting your lot with the spraying of B.t. this summer.

If your lot is situated within the identified sectors, please contact the Syndicate office:

LÉONARD LEBLANC
392-4466

In addition, an important information meeting will be held in:

MUNICIPALITY: BONAVENTURE
PLACE: CULTURAL CENTER
DATE: MARCH 13, 1985
TIME: 19 H 30

C.P. 9, 264, boul. Perron Est, Caps-Noirs, (New Richmond) (Québec) G0C 1C0 - Tél. (418) 392-4466

It is very important that you attend this meeting in order to give us the authorization to protect your lot against the spruce budworm.

Your truly,

Bernard Landry, Forestry Eng.
DEVELOPMENT DIRECTOR

BL:lc
Encl.

APPENDIX 7. MEMORANDUM OF AGREEMENT BETWEEN THE EXECUTING ORGANIZATION AND THE WOODLOT OWNER

MEMORANDUM OF UNDERSTANDING

BETWEEN

The La Pocatière Region Wood Producers' Marketing Board duly represented by Mr. Louis Brunet.

AND

Mr. (Ms.)____

WHEREAS Mr. (Ms.)____
declares that he (she) is, in good title, the "absolute owner" of the property described hereinafter;

_______________ _______________ _______________

_______________ _______________ _______________

_______________ _______________ _______________

_______________ _______________ _______________

WHEREAS the said property is seriously affected by the spruce budworm infestation;

WHEREAS the La Pocatière Region Wood Producers' Marketing Board has signed a contract with the Canadian Forestry Service for application of a biological insecticide (B.t.) under the forestry program of the Eastern Quebec Development Plan, wherever such protection is justified;

The above-mentioned parties agree as follows:

1. The owner

1.1 Shall ask the La Pocatière Region Wood Producers' Marketing Board to spray his or her woodlot with a biological insecticide (B.t.), free of charge, in order to protect it against the current spruce budworm infestation;

1.2 Shall allow free access to the property at all times by technical staff of the Canadian Forestry Service and the La Pocatière Region Wood Producers' Marketing Board or their contractors, before, during and after the spraying;

1.3 Shall cooperate in indicating, as necessary, the part of the said property requiring treatment;

1.4 Shall liberate the La Pocatière Region Wood Producers' Marketing Board of the responsibility for any loss, expense, damage, demand or claim arising from accidental bodily harm which may occur to anyone on the property, or for any damage caused to the property under this project;

.../2

1.5 Shall consent to the establishment of sample plots on the property, with which he or she may not interfere without the permission of the Canadian Forestry Service or the La Pocatière Region Wood Producers' Marketing Board for the duration of this agreement.

2. The La Pocatière Region Wood Producers' Marketing Board

2.1 Shall spray or have sprayed a solution of biological insecticide (B.t.) on the said property insofar as meteorological conditions and operational constraints permit;

2.2 Shall provide technical personnel for the execution, supervision, and monitoring of this operation;

2.3 Shall evaluate the success of the operation in the field;

2.4 Shall use only a safe perticide (registered biological insecticide) and comply with recognized standards and precautions for its use.

This memorandum of understanding shall be in effect from the date of signing until December 31, 1986.

In witness whereof, the two parties have signed in the presence of the following witnesses:

The owner ______________________________

Witness ______________________________

Signed at ______________________ on ____________

The Board ______________________________

Witness ______________________________

Signed at ______________________ on ____________

APPENDIX 8. LETTER SENT TO OWNERS WHOSE LOTS WERE NOT TREATED

LE SYNDICAT
DES PRODUCTEURS DE BOIS
DE LA GASPÉSIE

August 3, 1987

To Private Woodlot Owners

SUBJECT: Aerial spraying of B.t. in private forests

Dear Madam:
Dear Sir:

Your forestry property was selected for an aerial spraying protection program against the spruce budworm offered by the Woodproducers' Association of Gaspesia in collaboration with the Canadian Forestry Service.

Following an inventory that was taken before spraying began, six (6) blocks of private woodlots were eliminated from the spraying program because the larval population did not justify such an operation. Your property is located in one of these blocks and was thus withdrawn from the program this year.

We would like to thank you for your interest and collaboration during the planning phase of this program. We will do everything possible to ensure that this program may be offered again, if the spruce budworm comes back in epidemic levels.

Sincerely yours,

Gaston Miousse, Forestry Eng.
Head of the Spraying Project

C.P. 9, 264, boul. Perron Est, Caps-Noirs, (New Richmond) (Québec) G0C 1C0 · Tél. (418) 392-4466

APPENDIX 9. INFORMATION LETTER SENT TO WOODLOT OWNERS INDICATING THE LOCATION OF SPRAY BLOCKS AND THE LOTS INVOLVED

Le Syndicat des Producteurs de Bois de la Gaspésie

C.P. 9, Caps-Noirs (New Richmond),
Comté Bonaventure, Qué. - G0C 1C0
Tél.: 392-4466

October, 23th, 1986

Dear Madam,
Dear Sir,

Your forestry property was included in the B.t. biological insecticide spraying program under the responsibility of the S.P.B.G. (the Woodproducers Syndicate of Gaspesia), with technical and financial aid from the Canadian Forestry Service, in order to fight against the spruce budworm.

This program allowed the protection of 14 629 hectares of forest in eastern Quebec, of which 4 319 hectares were in your Syndicate's territory. This activity, realized at a cost of $46.83/ha ($18.95/acre), was financed within the framework of the forestry program of the Development Plan of Eastern Quebec (Eastern Plan - Plan de l'Est).

Enclosed, you will find a map locating the treated block that included your property and a descriptive file of the results obtained.

Without your collaboration, this program would not have been such a success. This is why we are thanking you and we will do all that is possible so that this program against the spruce budworm will be offered again in future years, if the need is still there.

Sincerely yours,

Gaston Miousse

GM:lc

Gaston Miousse, Forestry Eng.
Head of the project

ENC.

DESCRIPTION FILE

NAME: ____________________

ADDRESS: ____________________

____

____

PROPERTIES TREATED:

LOT __________ RANGE ________ TOWNSHIP ____________________

LOT __________ RANGE ________ TOWNSHIP ____________________

LOT __________ RANGE ________ TOWNSHIP ____________________

LOT __________ RANGE ________ TOWNSHIP ____________________

NO. OF BLOCK SPRAYED: ____________________

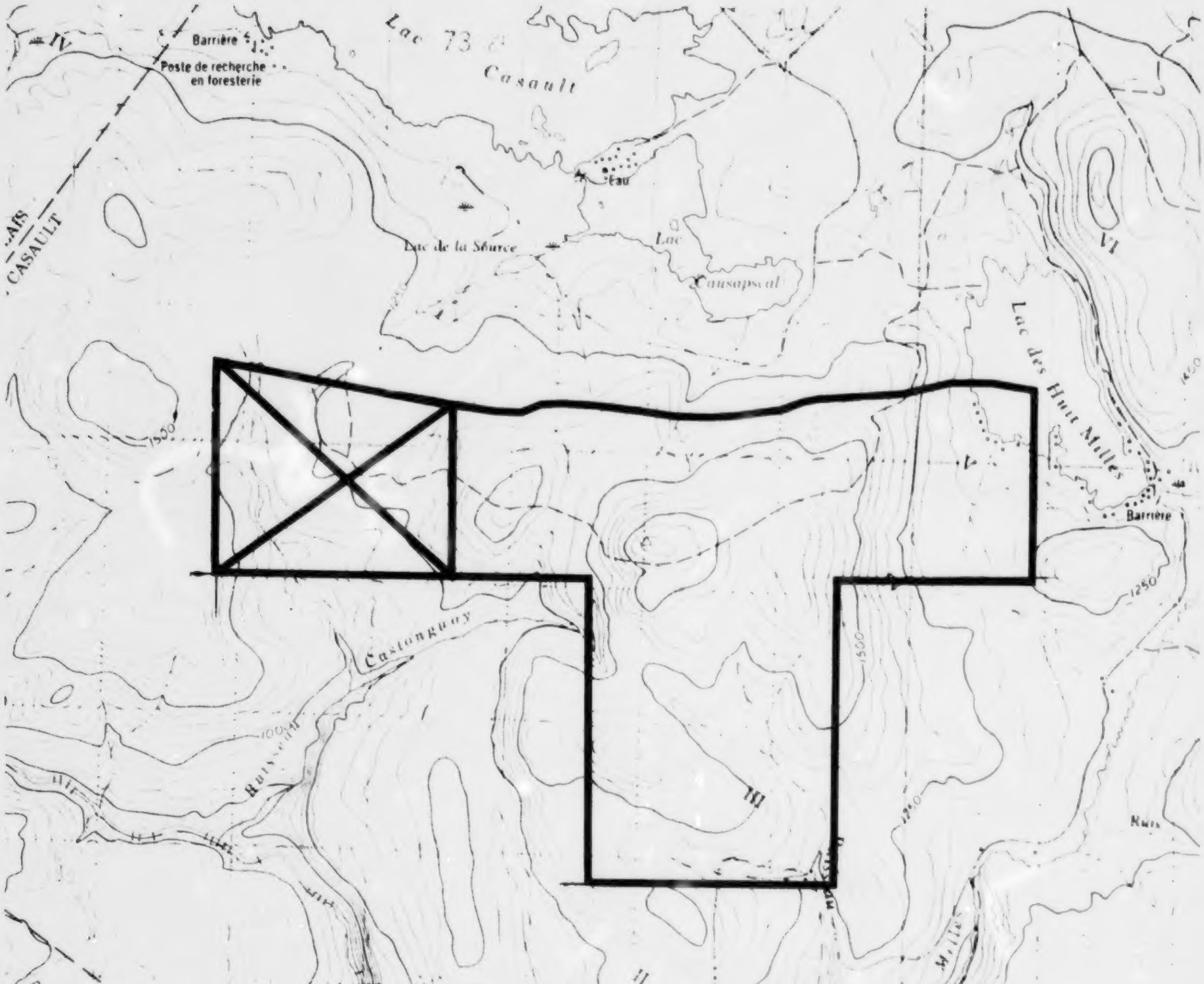
DATE OF TREATMENT: ____________________

RATE OF LARVA MORTALITY: ____________________

PERCENTAGE OF DEFOLIATION IN 1986: __________

PERSON IN CHARGE OF SECTOR:

Gaston Miousse, Forestry Eng.
S.P.B.G. (Wood Producer's Syndicate)
Box 9
Black Cape
G0C 1C0
TEL NO: 392-4466

Barrière
Poste de recherche en foresterie
Lac 73 Casault
CASAULT
Eau
Lac de la Source
Lac Causapscal
Lac des Huit Milles
Barrière
1500
1250
Castonguay
Ruisseau
1000
III
II
I
V
VI
IV
IV SE
Ruisseau Carleton
CAUSAPSCAL
Ruisseau
BLOCK 360
S
C

APPENDIX 10. PRESS RELEASE PUBLISHED TO INFORM THE PUBLIC BEFORE SPRAYING OPERATIONS BEGAN

NEWS RELEASE

PRESS RELEASE

Biological Treatment of Private Woodlots Against the Spruce Budworm

---

(June 10, 1985) - This year, for the first time, privately owned forests in the Lower St. Lawrence and Gaspé region will benefit from a biological insecticide spraying program to combat the spruce budworm. The biological insecticide used is a Bacillus thuringiensis (B.t.) preparation. All studies conducted to date clearly demonstrate the safety of this biological treatment which has proven effective in the fight against the spruce budworm.

Protective programs for public forests have been in existence for a very long time, but a general program for private woodlots has never been created before. Woodlot owners have frequently deplored this shortcoming and have made repeated efforts to obtain protection for their coniferous forests.

.../2

The Canadian Forestry Service (CFS) has retained the services of two wood producers' syndicates and one wood producers' marketing board in the region (La Pocatière, Lower St. Lawrence and Gaspé) to plan and carry out the spraying program, a new development tool previously unavailable to private woodlot owners in Quebec. The project is a component of the forestry program of the Eastern Quebec Development Plan.

In March, the CFS and the syndicates held 14 meetings in the Gaspé and Lower St. Lawrence region to inform private woodlot owners and local organizations of the program, and to obtain agreement from the persons concerned. Spraying will be carried out only in affected forests which are likely to respond to the treatment and whose owners have submitted written applications. Approximately 1,200 private woodlot owners have asked to be included in the spraying program.

It will be remembered that in spring 1984 the Canadian Forestry Service, with the cooperation of the Gaspé Region Wood Producers' Syndicate, treated 3,800 ha of private forest in the Gaspé region. This experiment created considerable interest among owners struggling with the problem of the spruce budworm and allowed its organizers to prove the feasibility of this type of activity in private woodlots.

.../3

This year, the syndicates and the board expect to treat approximately 38,000 ha of the territory covered by the Eastern Quebec Development Plan. This area is distributed throughout the region. Land and aerial cartographic inventories have permitted identification of over fifty sectors that require protection, that is, where 1985 defoliation is likely to be moderate or severe and where mortality has been observed in less than fifty percent of the trees in the stand.

The Bacillus thuringiensis preparation will be sprayed from Grumman AgCat single-engine airplanes beginning in early June and continuing for a period of approximately 20 days. A signalling system using helium balloons was designed and tested when the pilot project was conducted in 1984. This is a proven guidance system permitting very accurate application. Depending on atmospheric conditions, spraying will take place in the morning between 4:00 and 10:00 and in the evening between 19:00 and 21:00.

Staff from the board and the two syndicates are responsible for planning the program, providing information to owners and carrying out the spraying in accordance with the environmental requirements established for such projects.

.../4

The staff of the Laurentian Forest Research Centre will be responsible for product quality control, evaluation of spraying operations and analysis of the results.

Finally, it should be noted that individually or through their syndicates woodlot owners are making a financial contribution to this protection program.

The federal government will allocate approximately $ 1.4 million to the execution of this component of the forestry program of the Eastern Quebec Development Plan.

- 30 -

For information: Jean-Guy Gagnon
Canadian Forestry Service
Rimouski
(418) 722-3144

BIOLOGICAL TREATMENT
OF PRIVATE WOODLOTS
against the spruce budworm
IN THE VICINITY OF THE MUNICIPALITIES LISTED
By region and operational base

1 - La Pocatière
    Lower St. Lawrence
    Gaspé

2 - La Pocatière Region
    Base: NOTRE-DAME-DU-PORTAGE
    Base: OUELLE RIVER
    St-Antonin
    St-Bruno
    Mont-Carmel
    St-Paçome
    St-Onésime
    St-Gabriel-l'Allemand

3 - Lower St. Lawrence Region
    Base: CABANO
    Squatec
    Lejeune
    St-Honoré
    St-Jean-de-la-Lande

4 - Lower St. Lawrence Region
    Base: RIMOUSKI
    St-Gabriel
    St-Narcisse
    Esprit-Saint

5 - Lower St. Lawrence Region
    Base: MATANE
    St-Luc
    Ste-Félicité
    St-Jérôme-de-Matane
    St-Jean-de-Cherbourg
    Grosses-Roches
    Les Méchins

6 - Lower St. Lawrence Region
    Base: HEPPELL
    Albertville
    Ste-Florence
    Ste-Marguerite
    Routhierville
    St-François
    L'Ascension

7 - Gaspé Region
    Base: STE-ANNE-DES-MONTS
    Cap Chat

8 - Gaspé Region
    Base: RIVIERE-MADELEINE
    Mont-Louis
    Rivière-Madeleine
    Gaspé-Nord

9 - Gaspé Region
    Base: BONAVENTURE
    Newport
    Pabos Mills
    St-Elzear
    Bonaventure
    New Carlisle
    St-Alphonse

10 - Gaspé Region
    Base: ST-JULES
    New Richmond
    St-Omer
    Nouvelle
    Escuminac

APPENDIX 11. ANNOUNCEMENT PUBLISHED IN WEEKLY NEWSPAPERS

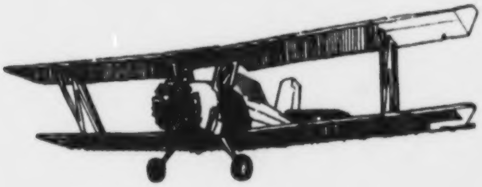
SPRUCE BUDWORM CONTROL

BIOLOGICAL

TREATMENT FOR PRIVATE WOODLOTS

Arial Spraying of a biological insecticide will get underway at the beginning of June. These spraying operations are necessary in order to curb the devastating effects of the spruce budworm.

This biological insecticide is not hazardous the population's health or to the environment.



where?

Lower St. Lawrence and Gaspé Region. Treated areas in your region: Sainte-Marguerite and Albertville.

how?

Under the responsibility of the wood producers' associations of your region, there will be an aerial spraying of the biological insecticide *B.T.* (*Bacillus thuringiensis*).

when?

The spraying will take place during the period of June 3 to 25, weather permitting. Spraying will generally be carried out in the early morning, between 4 and 10 a.m., or in the evening between 7 and 9 p.m. The local radio station will keep you informed as to what area will be treated. You can also call collect (La Pocatière) 0-856-4639, 7 days a week, 24 hours a day, for information on the area to be treated.

why?

Biological treatment of private woodlots is necessary to keep the forest alive and maintain vitality in this sector of the economy.

priority

Only those woodlots affected and likely to benefit from the treatment wil be sprayed, with the approval of the owners.

IN COOPERATION WITH:

l'Office des producteurs de bois de la region de la Pocatiere
le Syndicat des producteurs de bois du Bas-Saint-Laurent
le Syndicat des producteurs de bois de la Gaspésie

Eastern Quebec Development Plan

Forestry Program

Government of Canada
Gouvernement du Canada

Canadian Forestry Service
Service canadien des forets

Canada

APPENDIX 12. RADIO ANNOUNCEMENT BROADCAST DURING THE SPRAYING PERIOD

Marketel Publim
COMMUNICATEURS • CONSEILS

TEXTE PUBLICITAIRE

Page 1 de 1

Client:	FORESTRY CANADA		
Produit:	Radio message "Biological treatment"	IMPRIMÉ ☐	RADIO ☐
No. dossier:	QFORC-017	Format:	
Date:	May 5, 1989	Couleurs:	
Révision:		Durée:	30 SECONDES

Public interest message.

Forestry Canada, in cooperation with the wood producers' associations of your region are presently in the process of using a biological treatment to control the spruce budworm on private woodlots.

"DONUT"
(announcer)

Today, June _______, spraying will take place in the area of __________ between 4 and 10 a.m. and in the area of _________ between 7 and 9 p.m., weather permitting.

For more information, call collect New Richmond 0-392-4396.

This has been a message from Forestry Canada.

Marketel Publim (1987) Inc.
871, Chemin Saint-Louis
Québec (Québec) G1S 1C1
Tél. : (418) 683-4931

APPENDIX 13. PRESS RELEASE INFORMING THE PUBLIC OF THE RESULTS OF THE SPRAY PROGRAM

Office des Producteurs de Bois de la Région de La Pocatière

204, 4e Avenue, C.P. 760, La Pocatière, Qué. G0R 1Z0 Tél.: (418) 856-4639

For immediate publication

APPLICATION OF B.t. IN PRIVATE FORESTS
THE RESULTS LOOK VERY PROMISING

(La Pocatière, August 1, 1985) - Application of the biological insecticide B.t. in private forests in the La Pocatière region will give very satisfactory results, according to the preliminary findings of the technical staff who gather and analyze samples from the treated woodlots.

It will be remembered that the La Pocatière Region Wood Producers' Marketing Board, with the technical and financial support of the Canadian Forestry Service, conducted a spraying operation of B.t. last June 5th to 8th. Throughout the operation, CFS technical staff supervised and coordinated the spraying of close to 200 private woodlots for a total area of more than 6,500 hectares in four sectors.

.../2

To accomplish this work, it was necessary for the Board to hire 15 people to form the technical team. This spraying operation was achieved through the use of two operational bases located in the Office's territory. During the course of the activity, the woodlot owners were kept informed of the progress and the results were communicated to them as soon as possible. A final report should be completed by the fall of 1985.

Source: Louis Brunet, Forestry Eng.
(418) 856-4639

APPENDIX 14. LETTERS SENT TO OTHER ORGANIZATIONS DIRECTLY INVOLVED IN THE MANAGEMENT OF PRIVATE FORESTS

LE SYNDICAT
DES PRODUCTEURS DE BOIS
DE LA GASPÉSIE

April 16, 1985

Sent to: Messrs. Rénald Plourde, MRC, Avignon
Térence Coulombe, MRC, Denis Riverin
Robert Pidgeon, MRC, Côte de Gaspé
Allan Morris, MRC, Pabok
Jean-Guy Poirier, MRC, Bonaventure

Subject: Spraying of the biological insecticide Bacillus thuringiensis (B.t.) in the territory of the Woodproducers' Syndicate of Gaspesia

Dear Sir:

The purpose of this letter is to inform you that the Woodproducers' Syndicate of Gaspesia, in collaboration with the Canadian Forestry Service, will conduct a program for the application of B.t. against the spruce budworm on private woodlots between May 15th and June 15th, 1985.

This spraying is a logical follow-up of the experimental project carried out during the summer of 1984 by the Woodproducers' Syndicate of Gaspesia in collaboration with the Canadian Forestry Service. This dispersal of B.t. was a total success.

In addition, a document on spraying with the biological insecticide B.t. in private forests is available for consultation at our office. You will find enclosed a map detailing the blocks of lots identified in your territory.

For further information, please contact the undersigned at 392-4466.

Sincerely,

Gaston Miousse, Forestry Eng.
Project Leader

Encl.

c.c. Messrs. Jean-Marie Jobin, Sec.
Bernard Landry, Forestry Eng.

LE SYNDICAT
DES PRODUCTEURS DE BOIS
DE LA GASPÉSIE

March 25, 1985

To: Messrs. Gabriel Roy, Conservation Society, Pointe-Frégate, G0E 1G0
Camille Catilloux, Conservation Society, P.O. Box 64, Port-Daniel
Régis Chicoine, Conservation Society, P.O. Box 221, St-Siméon

Subject: B.t. spraying against the spruce budworm

Dear Sir:

Last year, for the first time in Canada, the Woodproducers' Syndicate of Gaspesia in collaboration with the Canadian Forestry Service, carried out experimental spraying of the biological insecticide B.t. in private forests.

B.t. (Bacillus thuringiensis) is a biological insecticide that has been used for more than 20 years all over the world and it is completely safe for man, predators, parasites, and even bees.

Last year's results were so conclusive (90% larval mortality in the treated zones) that the Canadian Forestry Service has signed a new contract which will allow the Woodproducers' Syndicate of Gaspesia to offer private woodlot owners the opportunity to protect their lots with B.t. spraying this summer.

If you require further information, do not hesitate to contact us at 392-4466.

Sincerely,

Gaston Miousse, Forestry Eng.
Project Leader

Encl.

c.c. Mr. Bernard Landry, Forestry Eng.

C.P. 9, 264, boul. Perron Est, Caps Noirs, (New Richmond) (Québec) G0C 1C0 - Tél. (418) 392-4466

TECHNICAL LEAFLET 3

APPENDIX 1. FORM FOR RECORDING METEOROLOGICAL DATA

Office des Producteurs de Bois de la Région de La Pocatière

Meteorological data — Aerial treatment **1986**

BLOCK NO:

LOCATION:

TREATMENT: *B.t.* Futura

START OF TREATMENT: hours

END OF TREATMENT: hours

DATE	HOUR	TEMPERATURE		R.H.	WINDS		CLOUD COVER
		DRY	HUMID	%	KM/H	DIRECTION	%

NOTES:

NUMBER OF FLIGHTS: BY:

TECHNICAL LEAFLET 4

APPENDIX 1. SPECIFICATIONS FOR PURCHASING *BACILLUS THURINGIENSIS*

Specification

Purchase of *Bacillus thuringiensis*

The following amount of *Bacillus thuringiensis* will be required: Futura 14.4 BIU/liter — 73 barrels × 200 L = 14,600 liters.

The product shall be delivered in 200-liter barrels, to destinations which will be specified before April 1, 1987. The product must be delivered on May 15, 1987.

All deliveries received after May 15, 1987 will be penalized as follows: we will only pay 50% of the regular cost for any amount of product received after May 15.

As a condition for our acceptance of all products received, your company **must** provide us with the following items (otherwise, rejected products will be taken back by your company at its own expense).

1) Within 15 days after the order is put in, your company will have to provide us with a copy of its standard protocol used to determine the insecticide activity of *B.t.*-based preparations. This copy will have to be approved and signed by the person in charge of quality control for biotests.

   This protocol must contain **at least**:
   - — components and method for mixing formula;
   - — standard and sample formulas;
   - — dilutions used and sequence of these dilutions;
   - — mixing of dilution in recipe;
   - — infestation with *Trichoplusia ni*;
   - — reading of biotest with a standard example of rough data obtained and used in calculating insecticide potentiality;
   - — calculations performed in measuring potentiality and variance value (with example);
   - — criteria used in selecting these biotest results;
   - — number of replicates per sample;
   - — a list of modifications performed on this protocol since 1980; and
   - — any technical deviation from the standardization on biotests approved at the July 28, 1982 conference in Brownsville, Texas, must be specified and explained.

   Within the same deadline, your company will also have to provide us with:
   - — the standard protocol used in determining whether the β-exotoxin of *Bacillus thuringiensis* is present or not in commercial preparations;
   - — a copy of methods used in verifying the **absence** of pathogenic substances for vertebrates in delivered material;
   - — a sample of the standard protocol used in performing a serotypia on the *Bacillus thuringiensis* used;
   - — a record of bacterial sensitivity to antibiotics for strain(s) of *Bacillus thuringiensis* [Kurstaki variety] used; and
   - — a copy of the protocol used in checking for bacteriophages in their final preparations.

   You will also have to indicate the type of crystal contained in strand(s) used.

2) Your company shall confirm, in writing, the **conservation period of the formula's insecticide potentiality**, and provide us with recommendations concerning long-term conservation of the product (one year or more).

3) Within one month after receiving this order, you must also provide us with a written guarantee that there are absolutely no pathogenic substances for vertebrates in your final formulas sold for aerial dispersion.

4) Within one month **after the order is put in**, your company shall **provide us with all** toxicological studies that were submitted to Agriculture Canada on *B.t.*-based preparations approved in Canada.

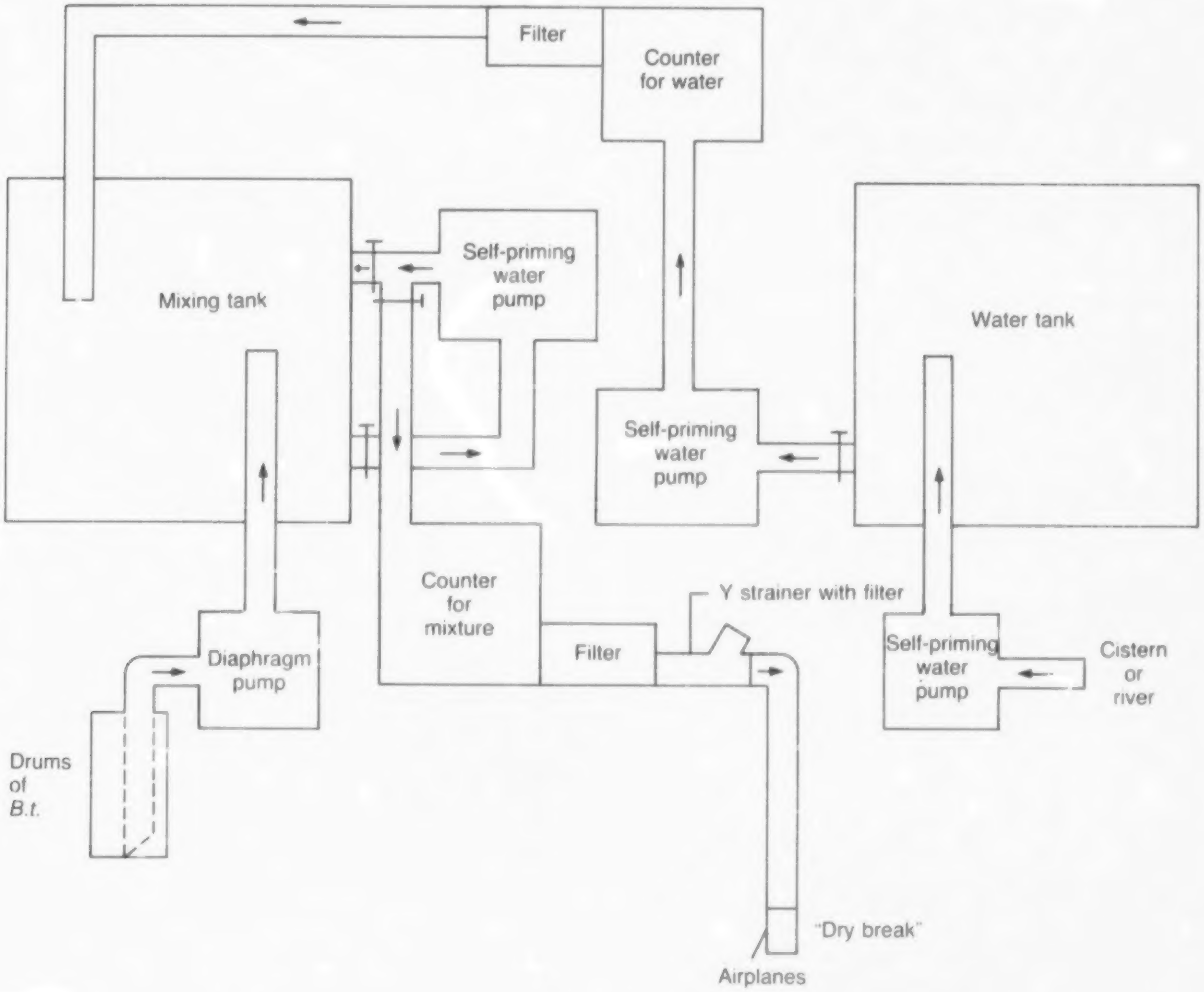
5) When the product is delivered, each batch must contain a copy of biotest results. A copy

of the test results from intraperitoneal injection in mice must also be provided with each batch. These two copies must be signed by the person in charge of quality control. Should any pathogenic substance be found in some products, those products would immediately be rejected.

6) The formula shall be made from primary powder of the same potential, in order to obtain a homogeneous product in terms of viscosity.

APPENDIX 2. MODEL OF A MIXING FACILITY

Model of a mixing facility.


Filter
Counter for water
Self-priming water pump
Mixing tank
Water tank
Self-priming water pump
Counter for mixture
Y strainer with filter
Filter
Diaphragm pump
Self-priming water pump
Cistern or river
Drums of *B.t.*
"Dry break"
Airplanes

APPENDIX 3. TABLE USED FOR MIXING THE FUTURA® FORMULA FOR SPRAYING AT A CONCENTRATION OF 20 × 10^9 INTERNATIONAL UNITS PER HECTARE IN A FINAL VOLUME OF 2.5 L/HA

Table for mixing the Futura® Formula.

Basic formula: 1.5 L of *B.t.* 60%
1.0 L of water 40%

Final volume: 2.5 L/ha

Number of barrels	Quantity of *B.t.* (U.S. gal)	Quantity of water (U.S. gal)	Quantity of final mixture (U.S. gal)
1	52	35	87
2	105	70	175
3	157	105	262
4	210	140	350
5	263	175	438
6	315	210	525
7	368	246	614
8	421	281	702
9	474	316	790
10	526	351	877
11	579	386	965
12	632	421	1 053

APPENDIX 4. DETAILED DESCRIPTIONS OF THE MIXING FACILITIES USED

Mixing facility on a mobile home trailer

The Gaspé region used a mixing facility loaned by the Department of Energy and Resources. This system was composed of:

— two 4.700-L tanks (one for water and one for the *B.t.* and water mixture);

— one four-cylinder gas engine operating a pump used to:

(1) mix the pesticide with water, and

(2) fill the airplanes;

— one two-cylinder gas engine operating a pump used to pump *B.t.* into the tank;

— one water pump with a 5-cm inlet and outlet;

— one counter with a calibrated filter for water; and

— one counter with a calibrated filter for the *B.t.* and water mixture.

This equipment was mounted on a six-wheel trailer (mobile home chassis) and pulled, as necessary, by a truck tractor used for transporting mobile homes and rented by the Gaspé Region Wood Producers' Syndicate. A supply of water was transported by a tank on a rented truck.

Mixing facility on a trailer handled by a three-axle truck

In light of the small area of some blocks in this region and the many trips to be made, the Lower St. Lawrence Wood Producers' Syndicate opted for a mixing system built according to ForCan specifications. This mixing facility was composed of the following:

— two 3.400-L fibreglass tanks;

— PVC pipes, valves and filters;

— one Rockwell counter graduated in litres;

— one 5-cm self-priming water pump;

— one 5-cm diaphragm pump; and

— one 5-cm water pump.

This system was mounted on a forestry trailer pulled by a flatbed truck equipped with a hydraulic loading arm. The truck was also used to transport barrels of *B.t.* from one site to another. The entire system was therefore very mobile and highly suited to this type of operation.

Mixing facility on a truck trailer

The components of this mixing facility were as follows:

— one 9.000-L water tank;

— one 9.000-L tank for the *B.t.* and water mixture;

— one water pump with a 5-cm inlet and outlet, and a manual starter;

— two self-priming water pumps with a 10-cm inlet and outlet, and an electric starter;

— one diaphragm pump with a 5-cm inlet and outlet used to pump undiluted *B.t.* into the barrels;

— one counter with filter, calibrated for water in U.S. gallons, with a 10-cm inlet and outlet;

— one counter with filter, calibrated for the *B.t.* and water mixture in U.S. gallons, with a 10-cm inlet and a 5-cm outlet;

— one Y strainer with a 40-mesh filter; and

— one 5-cm dry break.

All the equipment was mounted on a two-axle trailer 13 m long and 2.5 m wide.

APPENDIX 5. ANNOUNCEMENT OF PUBLIC TENDER TO HIRE A SPRAY CONTRACTOR

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OFFICE DES PRODUCTEURS DE BOIS
DE LA REGION DE LA POCATIERE

APPLICATION OF A BIOLOGICAL INSECTICIDE (B.t.) AGAINST THE SPRUCE BUDWORM IN PRIVATE FORESTS IN EASTERN QUEBEC

PUBLIC TENDER

FEBRUARY 28TH 1986

APPLICATION FOR TENDER

NAME: ______________________________

ADDRESS: ______________________________

HEAD: ______________________________

1. Type and number of aircraft planned

	2	4
- Grumman AgCat 450:	☐	☐
- Grumman AgCat 600:	☐	☐

2. Starting Amount

required by the contractor for a minimum treated area of 12,500 hectares

__________ $

3. Additional Costs

for supplementary hectares treated:

From 1 to 2,500 hectares	________ $/hectare
From 2,501 to 5,000 hectares	________ $/hectare
From 5,001 to 7,500 hectares	________ $/hectare
From 7,501 to 10,000 hectares	________ $/hectare
From 10,001 to 12,500 hectares	________ $/hectare

4. Comments

- Responsibilities of the contractor:

- Responsibilities of the Office:

- Penalties

- Others

____

____

____

____

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____

____

____

Signed at ____________________

this ________________ 1986

By: ____________________
Head

APPENDIX 6. CONTRACT BETWEEN THE EXECUTING ORGANIZATION AND THE SPRAY CONTRACTOR

CONTRACT
APPLICATION OF BIOLOGICAL INSECTICIDE (B.t.) AGAINST THE SPRUCE BUDWORM IN EASTERN QUEBEC PRIVATE WOODLOTS

Contract made at Rimouski, Province of Quebec, on

BETWEEN:

SYNDICAT DES PRODUCTEURS DE BOIS DU BAS ST-LAURENT

Hereinafter called the "Syndicat"

AND:

AGRIC AIR INC.
Hereinafter called the Contractor

The parties make the following mutual commitments:

1. RESPONSIBILITIES OF THE CONTRACTOR

The Contractor agrees to:

1.1 Carry out aerial spraying of a biological insecticide (B.t.) in the areas previously identified by the "Syndicat" or its representatives (see Appendixes I-A and I-B) during the appropriate period for combatting the spruce budworm, subject to clause 4.4;

1.2 Conduct spraying at a final mixture volume of 2.5 litres per hectare and comply with the calibration standards set out in Appendix II;

1.3 Supply two Grumman AgCat 450- or 600-HP aircraft equipped with spraying systems which have twenty-four or twenty-five, depending on the calibration, Teejet™ flat-fan 8004 booms and nozzles, as well as an air pump (wind driven) capable of producing a pressure of 30 psi, and to operate at an optimum load given the available airstrips and treatment areas;

1.4 Bring the aircraft described in clause 1.3 to the designated calibration site (Heppell) three days before the start of the spraying period, which shall normally begin in the first week of June. No fee shall be charged to the "Syndicat" or its representatives by the Contractor for the calibration operation;

1.5 Ensure that the personnel assigned to this contract are available during the calibration period and at the calibration site for a training session and that a manager is available for a few days to assist the "Syndicat" or its representatives during the planning phase;

1.6 Be present at the spraying sites, at the locations set out and on the dates determined by the "Syndicat" or its representatives, and be ready to conduct aerial spraying as authorized by the "Syndicat" or its representatives;

1.7 Ensure that personnel and material are available seven days a week, at any time suitable for spraying;

1.8 Equip each aircraft with a VHF radio system in good working order and provide the "Syndicat" or its representatives with the material required to ensure clear communications between the aircraft and the teams on the ground during the operation. The "Syndicat" shall be told, no later than May 10, 1987, which communication system has been selected for approval;

1.9 Provide the necessary ground personnel and support equipment to maintain the aircraft in good working order;

1.10 Pay the transportation, accommodation and living expenses of its personnel;

1.11 Provide the gasoline (quantity and speed of supply) and oil required to keep the aircraft in good working order and have a sufficient quantity of spare parts (nozzles, pumps, mechanical parts and so forth) available;

1.12 Ensure that the tanks and spraying equipment are cleaned after each spraying session;

1.13 Have an operating certificate from the Air Transport Committee (Canadian Transport Commission) valid for Class 7 AAD (aerial application and distribution) and any other certificate required and give the "Syndicat" copies before May 10, 1987. In addition, ensure that pilots have the permits required by the Canadian Transport Commission and are experienced in aerial spraying of private woodlots;

1.14 Pay landing, parking and security fees at the airports used, when attributable to the activity of the aircraft;

1.15 Comply with safe routes, dumping sites and spraying standards as set out in clauses 2.3, 2.4 and 2.6 hereof and in accordance with the requirements of the Quebec Department of the Environment.

1.16 Indemnify and declare the "Syndicat" or its representatives harmless from any damage caused to moveable and immoveable property resulting from the use of the equipment provided by the Contractor;

1.17 Obtain a public liability insurance policy in an amount of no less than one million dollars, wherein the "Syndicat" and its representatives shall appear as co-insured and which shall remain in effect for the duration of the 1987 spraying program. The policy shall cover any risk from May 15, 1987, and shall reach the

"Syndicat" thirty days before that date. It shall also contain a stipulation prohibiting any changes or cancellation throughout the entire spraying period without the written consent of the "Syndicat";

1.18 Guarantee that its equipment is in good working order and refund 100% of the cost of any product lost because of negligence which may be attributed to it;

1.19 Provide, upon signing of the contract, a binding letter of indemnity (see Appendix III) in the amount of one hundred thousand dollars to cover its withdrawal from the present contract.

2. RESPONSIBILITIES OF THE "SYNDICAT"

The "Syndicat" or its representatives undertake to:

2.1 Determine dates and sequences for spraying the biological insecticide;

2.2 Identify the airstrips (airports, roads, fields or other) and obtain authorization for their use;

2.3 Establish safe routes between the airstrips and the spray blocks, to ensure that inhabited areas are avoided;

2.4 Identify appropriate dumping sites to be used in case of emergency;

2.5 Inform the Contractor of the opportune time for calibration of the two aircraft at Heppell;

2.6 Provide the Contractor with aerial spraying standards for the biological insecticide used, as well as meteorological standards and the environmental requirements to be complied with;

2.7 Give pilots instructions with respect to aspects of the operation such as signalling, routes, emergency dumping sites, specifications for the biological insecticides used and any other environmental requirements;

2.8 Monitor insect development and annual growth in order to determine the precise spraying periods and thus tell the Contractor when to apply the biological insecticide;

2.9 Operate the mixing systems required for spraying and ensure the equipment is supplied as necessary to obtain the best possible results;

2.10 Pay the Contractor in accordance with Appendix IV and only for areas treated to the satisfaction of the "Syndicat" or its representatives and included in the areas previously identified;

2.11 Pay thirty percent of the minimum amount set out in Appendix III when the aircraft have been calibrated at Heppell, forty percent of the same amount on July 1, 1987, and the balance forty-five days following completion of the spraying, after deducting the amount attached to any penalty set out herein, provided it is attributable to negligence on the part of the Contractor.

3. PENALTIES

3.1 The "Syndicat" shall deduct from the amount set out in the contract the sum of two thousand five hundred dollars for each spraying period (half-day suitable for spraying) during which spraying did not take place, as well as any additional costs incurred by the "Syndicat" for delays resulting from the following circumstances:

- lack of spare parts required to keep the aircraft and spraying system in good running order;
- lack of gasoline occasioning a delay or loss of a spraying period;
- unavailability of one or more pilots for reasons not justifiable in professional terms;
- unavailability of one or more aircraft beyond the twenty-four hours normally granted in cases of unavailability due to a crash or other reasons which are acceptable in the estimation of the "Syndicat" or its representatives; or
- any other reason not directly attributable to the "Syndicat" or its representatives.

If the whole of the contract is completed in the period set out, the penalties shall be abolished and the Contractor shall be penalized only for additional costs incurred by the "Syndicat" or its representatives.

4. GENERAL

4.1 This contract shall come into effect when signed by the two parties and shall terminate on August 31, 1987;

4.2 Notwithstanding the letter if indemnity, where the Contractor does not fulfil any of its contractual obligations, the "Syndicat" may cancel this contract;

4.3 This contract may be amended subject to the written consent of both parties;

4.4 The "Syndicat" reserves the right to withdraw any areas included in Appendix I-B which, in the estimation of the "Syndicat" or its representatives, no longer require spraying as initially set out.

Signed in duplicate,

At Ste-Cécile-de-Milton, Québec, on April 24

NINETEEN HUNDRED AND EIGHTY-SEVEN (1987).

BY: (signed)
CONTRACTOR

(signed)
WITNESS

At ______________________________, on ____________________

NINETEEN HUNDRED AND EIGHTY-SEVEN (1987).

BY: (signed)
THE "SYNDICAT"

____
WITNESS

APPENDIX I-A

Syndicat des Producteurs de Bois du Bas St-Laurent
284 Potvin Street
RIMOUSKI, Quebec
G5L 7P5

Telephone: (418) 722-7211

Attention: Mr. Marc Bellavance
Forestry Engineer, Project Manager

Gaspé Region Wood
Producer's Syndicate
264 Perron Boulevard East
NEW RICHMOND, Quebec
G0C 1C0

Telephone: (418) 392-4466

Attention: Mr. Gaston Miousse
Forestry Engineer, Project Manager

APPENDIX I-B

FINAL BLOCKS

NUMBER	LOCATION	RESPONSIBILITY	ESTIMATED AREA	PLANNED AIRPORT
501	Albertville	LSLWPS[1]	4,100	Heppelll
502	Ste-Marguerite	LSLWPS	1,000	Heppelll
503	St-François-d'Assise	LSLWPS	1,100	St-François-d'Assise
504	St-André-de-Restigouche	LSLWPS	200	St-François-d'Assise
505	L'Ascension	LSLWPS	3,000	St-François-d'Assise
506	Faribault	LSLWPS	600	to be determined
604	Nouvelle	GRWPS[2]	700	Nouvelle
605	Nouvelle	GRWPS	340	Nouvelle
637	Grande Vallée	GRWPS	200	Rivière-Madeleine
638	Rivière-Madeleine	GRWPS	300	Rivière-Madeleine
642	Manche D'Epé	GRWPS	770	Rivière-Madeleine
643	Gros Morne	GRWPS	780	Rivière-Madeleine
644	Mont-Louis	GRWPS	330	Rivière-Madeleine
645	Rivière-à-Claude	GRWPS	900	Ste-Anne-des-Monts or Rivière-Madeleine
647	Marsoui	GRWPS	350	Ste-Anne-des-Monts
648	Marsoui	GRWPS	360	Ste-Anne-des-Monts
651	Rivière-à-Martre	GRWPS	500	Ste-Anne-des-Monts
17 blocks		TOTAL	15,530 hectares	

N.B. See maps for approximate location of blocks.

[1] Syndicat des Producteurs de Bois du Bas St-Laurent

[2] Gaspé Region Wood Producer's Syndicate

APPENDIX II

CALIBRATION

General conditions

To ensure the success of the operation, application of the pesticide must meet a number of precise criteria determined after many years of research. Criteria have been established for the minimum number of droplets/cm^2, or the number of bacillus colonies/cm^2, the size of the droplets (droplet spectrum) and the final volume per hectare. After mounting the spraying system on the airplane, the pilot is required to conduct one or more flights over a sampling device previously set up to assess spraying quality. Calibration tests shall be conducted early in the morning or at sunset, when wind speed is at a minimum, and the plane shall be available with crew and material for the amount of time required to ascertain that it is perfectly calibrated.

Type of airplane

Grumman AgCat 450 or 600 HP

Calibration standards

- applied volume: 2.5 L/ha
- distance between spray lines: 30 m
- flying speed during spraying: 176 km/h
- rate of flow: 22.3 L/minute
- spray pressure: 1.68 kg/cm^2 (may vary between 1.61 and 1.75 kg/cm^2, depending on the type of Grumman AgCat used)
- spray system: Teejet^{TM} flat-fan 8004 booms and nozzles placed at a 45° angle to the wind
- number of nozzles: twenty-four or twenty-five, depending on the type of Grumman AgCat (450 or 600 HP)
- area treated in one minute: 8.9 ha
- deposit for one airplane pass: 100,000 viable spores/cm^2 or six droplets/cm^2

APPENDIX III

BANK

March 29, 1988

Syndicat des Producteurs
de Bois du Bas St-Laurent
284 Potvin Street
Rimouski, Quebec
G5L 7P5

Dear Sir:

Re: Our Irrevocable First Demand Letter of Guarantee no. X-.....

We establish in your favour and for the account of .... our irrevocable first demand letter of guarantee for an amount up to in the aggregate, a maximum of C$ .... (.............................Canadian Dollars).

This irrevocable first demand letter of guarantee is issued in reference to the application of the biological insecticide B.t. against spruce budworm in private woodlots in eastern Quebec.

The amount payable under this irrevocable first demand letter of guarantee will be payable to you at your first demand despite any contestation or dispute between you and .... referring to our irrevocable first demand letter of guarantee reference number X-........... in the manner most convenient to you upon presentation of the following document to ....:

1. Your signed statutory declaration that the contract was not respected by ....

Any claim under this irrevocable first demand letter of guarantee must be received by us at .... on/or before .... (Expiry Date). No claim may be received and paid after the Expiry date.

Our responsibility under this irrevocable first demand letter of guarantee shall not exceed in the aggregate, the amount of C$ ....

March 29, 1988

The terms of this irrevocable first demand letter of guarantee set forth in full the terms of our undertaking and this undertaking is not in any way modified, amended or amplified by reference to any document, instrument or guarantee referred to in this irrevocable first demand letter of guarantee or in which this irrevocable first demand letter of guarantee is referred to, or to which this irrevocable first demand letter of guarantee is related and any such reference does not incorporate by reference any document, instrument or agreement.

Any correspondence or demand must make reference to our irrevocable first demand letter of guarantee no. X .... and must be received by ....

Yours truly,

Authorized signature

Authorized signature

APPENDIX IV

A minimum of $86,000 shall be paid for treatment of an area of 10,000 ha or less. For treatment of an area greater than 10,000 ha, the $86,000 minimum shall be paid and payment for treatment of additional areas shall be based on the following categories:

ADDITIONAL AREA TREATED	COST/HA	MAXIMUM ADDITIONAL AMOUNTS PAID FOR EACH AREA CATEGORY
1-2,500 ha	$7.00	$17,500
2,501-5,000 ha	$5.00	$12,500
5,001-5,600 ha	$4.00	$2,400

SAMPLE CALCULATION

For treatment of a 15,300-ha area, the total amount payable would be:

Base amount:	$ 86,000
Maximum additional amount for first category (2,500 ha X $7)	17,500
SUBTOTAL	$ 103,500
Maximum additional amount for second category (2,500 ha X $5)	12,500
SUBTOTAL	$ 116,000
300 ha X rate for third category ($4)	1,200
TOTAL AMOUNT PAYABLE FOR TREATMENT OF 15,300 HA	$ 117,200

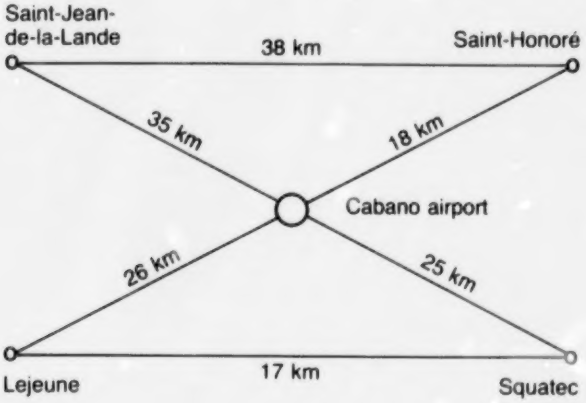
APPENDIX 7. OPERATION SIMULATION OF AERIAL SPRAYING

Operation simulation

Premises

1. One airplane treats 400 ha/flight.
2. There are two airplanes per mixing facility.
3. Spraying is carefully staggered.
4. Weather conditions are good.

Day 1 (Actual)



Airplane A (One flight)

Treatment area

— St-Jean-de-la-Lande:		182 ha
— St-Honoré:		196 ha
	Total:	378 ha

Total distance: 91 km

Number of workers needed

— St-Jean-de-la-Lande: 3 persons

— St-Honoré: 4 to 6 persons

Airplane B (One flight)

Treatment area

— Squatec:		306 ha
— Lejeune:		109 ha
	Total:	415 ha

Total distance: 68 km

Number of workers needed

— Squatec: 2 persons

— Lejeune: 2 persons

* Total number of workers required at the same time : 11 to 13 persons.

Airplane B (Two flights)

Treatment area

— St-Gabriel:		263 ha
— St-Narcisse:		181 ha
	Total:	444 ha

Flying distance

— St-Gabriel:		96 km
— St-Narcisse:		48 km
	Total:	144 km

Number of workers required: 8 persons

Airplane A (Two flights)

Treatment area

— Esprit-Saint:		400 ha
— Esprit-Saint & St-Narcisse:		248 ha
St-Narcisse:		100 ha
	Total:	748 ha

Flying distance

— Esprit-Saint:		46 km
— Esprit-Saint & St-Narcisse:		69 km
	Total:	115 km

Number of workers required

— Esprit-Saint: 5 persons

— St-Narcisse: 2 persons

Airplane B (One flight)

Treatment area

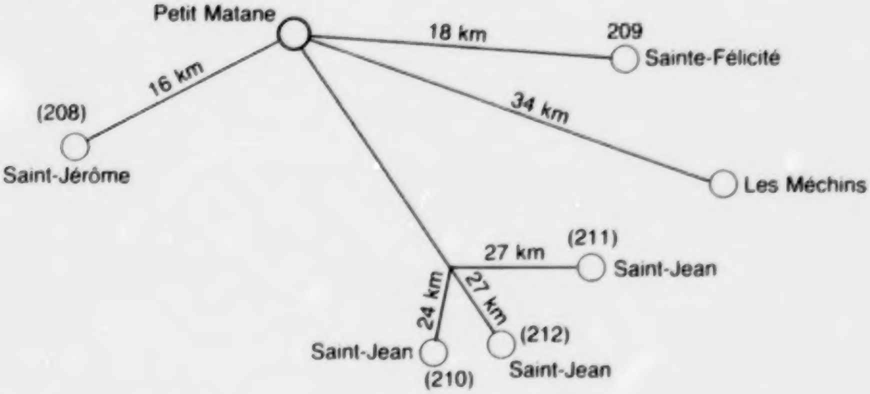
— St-Gabriel:		263 ha
— St-Narcisse:		81 ha
	Total:	344 ha

Flying distance: 110 km

Number of workers required

- — St-Gabriel: 3 persons
- — St-Narcisse: 2 persons

Day 3 (Matane Airport)


Petit Matane
16 km
(208)
Saint-Jérôme
18 km
209
Sainte-Félicité
34 km
Les Méchins
27 km
(211)
Saint-Jean
24 km
27 km
(212)
Saint-Jean
Saint-Jean
(210)

Airplane A (Three flights)

Treatment area

— St-Jérôme:		328 ha
— Ste-Félicité:		354 ha
— Les Méchins:		235 ha
	Total:	917 ha

Flying distance

— St-Jérôme:		16 km
— Ste-Félicité:		36 km
— Les Méchins:		68 km
	Total:	120 km

Number of workers required

— St-Jérôme:	3 persons
— Ste-Félicité:	3 persons
— Les Méchins:	3 to 5 persons
Total:	9 to 11 persons

Airplane B

Treatment area

— St-Jean 211:		400 ha
— St-Jean 211:		93 ha
St-Jean 212:		307 ha
— St-Jean 212:		175 ha
St-Jean 210:		205 ha
	Total:	1,180 ha

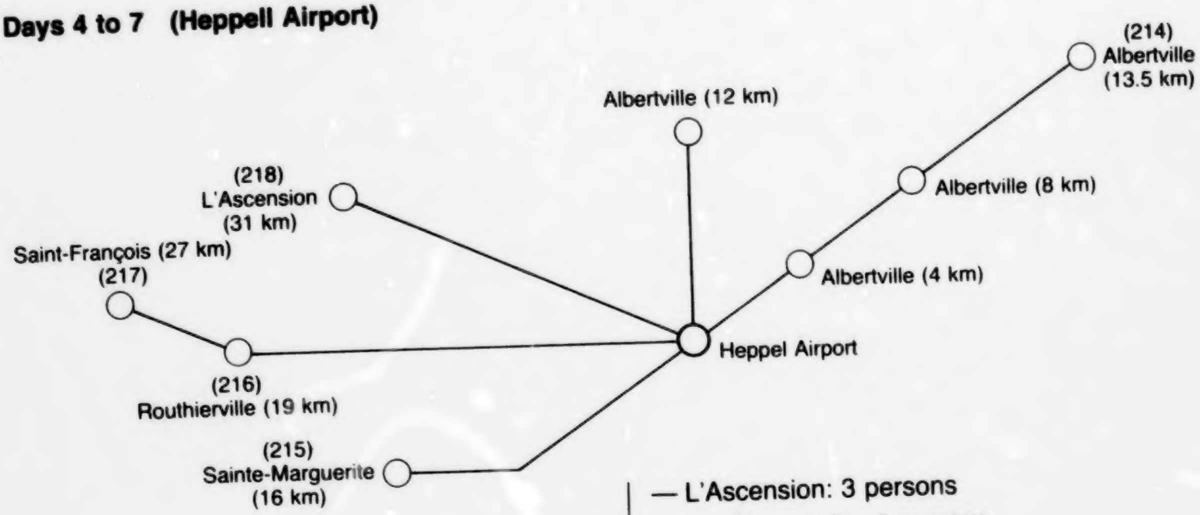
Flying distance

— St-Jean 211:		54 km
— St-Jean 211 + 212:		56 km
— St-Jean 212 + 210:		57 km
	Total:	167 km

Number of workers required

— St-Jean 211:	3 persons
— St-Jean 211 + 212:	1 person from 211 + 1 other person
— St-Jean 211 + 210:	2 persons from 211 + 1 other person
Total:	5 persons

Days 4 to 7 (Heppell Airport)


(214)
Albertville
(13.5 km)
Albertville (12 km)
(218)
L'Ascension
(31 km)
Albertville (8 km)
Saint-François (27 km)
(217)
Albertville (4 km)
Heppel Airport
(216)
Routhierville (19 km)
(215)
Sainte-Marguerite
(16 km)

Airplane A (Ten flights)

Treatment area

— Routhierville:	398 ha
— St-François:	365 ha
— L'Ascension:	400 ha
— L'Ascension:	233 ha
— L'Ascension:	237 ha
— Ste-Marguerite:	165 ha
— Albertville:	400 ha
— Albertville:	389 ha
— Albertville:	411 ha
— Albertville:	400 ha
Total:	3,398 ha

Flying distance

— Routhierville:	38 km
— St-François:	54 km
— L'Ascension:	3 × 62 km
— Ste-Marguerite:	32 km
— Albertville:	8 km
— Albertville:	20 km
— Albertville:	10 km
— Albertville:	10 km
Total:	358 km

Number of workers required

— Routhierville: 3 persons
— St-François: 3 persons
— L'Ascension: 3 persons
— Ste-Marguerite: 4 persons
— Albertville blocks: to be determined

Airplane B (Ten flights)

Treatment area:

— Albertville:	404 ha
— Albertville:	396 ha
— Albertville:	400 ha
— Albertville:	399 ha
— Albertville:	399 ha
— Albertville:	400 ha
— Albertville:	400 ha
— Albertville:	402 ha
— Albertville:	375 ha
— Albertville:	356 ha
Total:	3,931 ha

Flying distance

— Albertville:	27 km
— Albertville:	20 km
— Albertville:	20 km
— Albertville:	18 km
— Albertville:	18 km
— Albertville:	16 km
— Albertville:	16 km
— Albertville:	14 km
— Albertville:	14 km
— Albertville:	12 km
Total:	175 km

APPENDIX 8. FORM USED FOR ESTIMATING THE NUMBER OF *BACILLUS THURINGIENSIS* COLONIES

Estimating the number of *Bacillus thuringiensis* colonies

Block No.: ....

Formula: ....

Examination date: ....

Incubation period: .... hours

SAMPLE NO	READINGS			COL./CM²		AVERAGE
	1	2	3	4	5	